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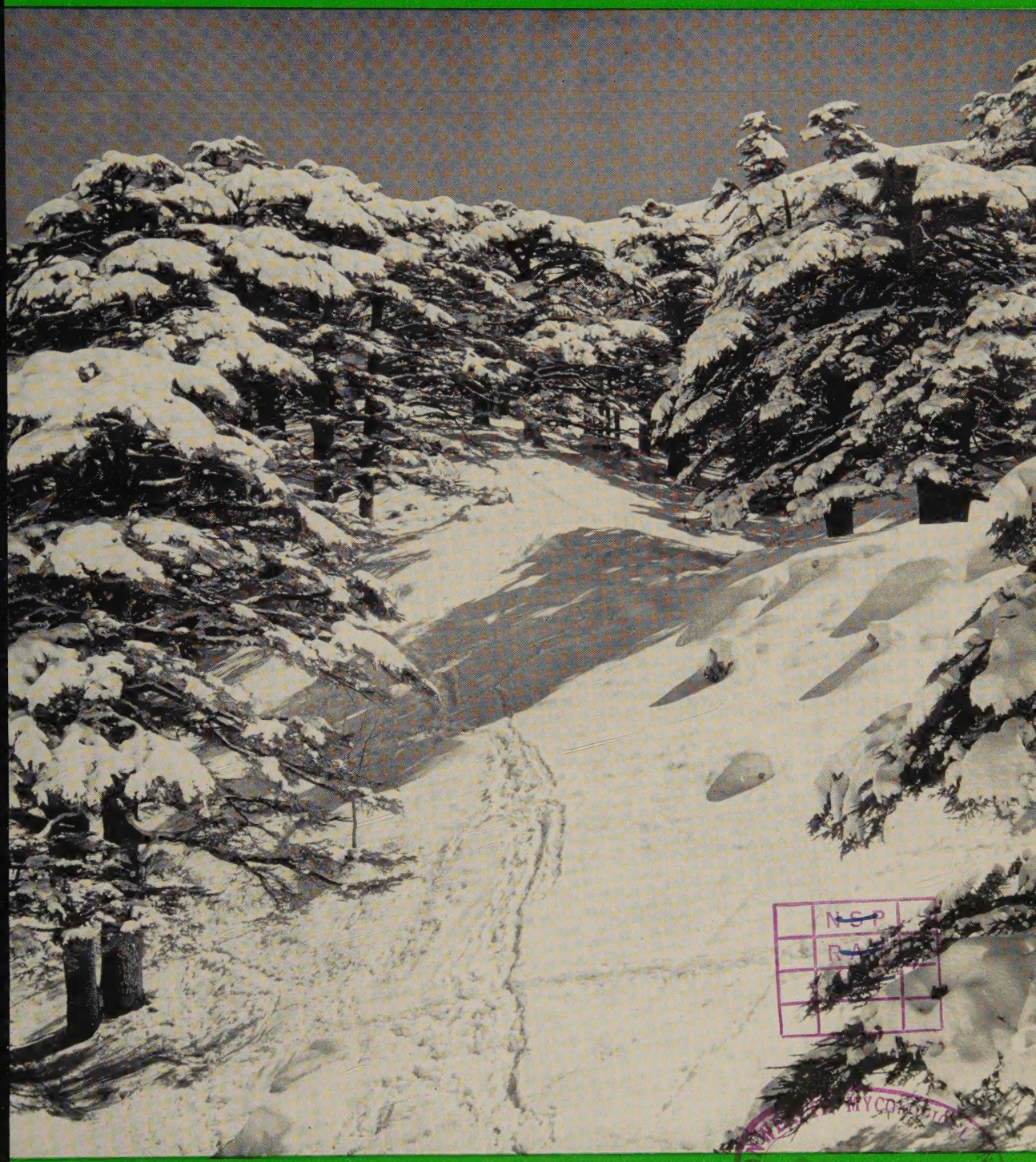
Unasylva

AN INTERNATIONAL REVIEW OF FORESTRY AND FOREST PRODUCTS



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COMMONWEALTH MYCOLOGICAL INSTITUTE
26 MAR 1962

VOLUME 15, NUMBER 4, 1961

Unasylva

1961 - Volume 15 Number 4

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Annual Subscription: U.S. $2.50 or 12s. 6d.
Single copy: U.S. $0.65 or 3s. 3d.

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FAO — The Food and Agriculture Organization of the United Nations — grew out of a United Nations Conference held at Hot Springs, Virginia, U.S.A., in May 1943. The nations agreed to work together to secure a lasting peace through freedom from want. The Organization was formally founded at Quebec, Canada, in October 1945. It was located at Washington D.C. until 1951 when the Headquarters office was moved to Rome.

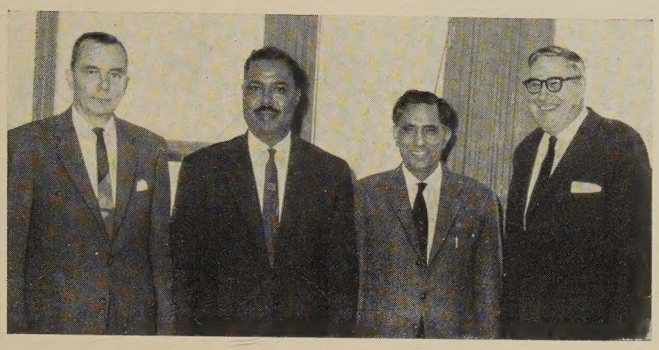
Unasylva is prepared by the Forestry and Forest Products Division (Director, Egon Glesinger; Editor, Leslie J. Vernell) and published quarterly. It attempts to cover a range of interest which is as wide as that of the Division whose work it mirrors. Signed articles express the opinions of the authors and do not necessarily represent the views of the Organization. All material in ***Unasylva*** may be freely reprinted, but acknowledgment is requested, together with a copy of the publication containing the reprint.

Cover photograph. *Some of the famous cedars of Lebanon* (Cedrus libanii) *which are now restricted to a small area in the Lebanese mountains. Steps are being taken to restore the tree cover on other parts of these uplands. A scheme for the integrated development of the montane zone has been drawn up by the Government. The United Nations Special Fund and FAO will participate in the project.*

Courtesy, Kersting

Unasylva

An International Review of Forestry and Forest Products



CONFERENCE OF FAO

Officers of the Technical Committee on Forestry and Forest Products. Left to right: A. L. Best (Canada) vice-chairman, Khalid Hamad (Sudan) chairman, Tasdique Husain (Pakistan) vice-chairman and Henry Clepper (U.S.A.) rapporteur.

THE CONFERENCE of the Food and Agriculture Organization of the United Nations concluded its eleventh session in Rome in November. In the course of the session it unanimously approved a 40 percent increase in the regular budget of the Organization and a program of work for 1962 and 1963 which provides for greatly expanded activity in the developing countries and particularly in those of Africa.

The Conference, which as the governing body of FAO meets once every two years, opened early in November with a call by Dr. B. R. Sen, the Director-General, for its members to accept responsibilities " which are inescapable if the member nations are to be assisted adequately in their struggle to achieve a better life for their peoples. "

John D. Rockefeller 3rd., Chairman of the Rockefeller Foundation, delivered the McDougall Memorial Lecture at the opening of the general discussion on the world food and agricultural situation. He said that the " unchecked growth " of world population " is second only to the control of atomic weapons as the paramount problem of our day," and called on member nations to " face the facts " on population growth and its implications and to determine whether " population stabilization " is necessary and feasible in their countries.

Under the chairmanship of Georges Khalil Haraoui, former Minister of Agriculture and Member of the Lebanese Parliament, the Conference approved 20 applications for membership bringing the total to 104 members and associates.

Acceleration of the Freedom from Hunger Campaign was mapped out, and a special program of education and training in Africa was approved, to be undertaken by FAO in co-operation with other interested specialized agencies of the United Nations. The Conference also authorized the Director-General to put a $100-million, three-year World Food Program into action as promptly as possible. The fund, partly in commodities and partly in cash, was proposed by the United States as an instrument to assist social and economic development. It is an elaboration of the World Food Board proposed in 1947 by Lord Boyd-Orr when Director-General of FAO, which failed at that time because the climate of international opinion was not ready for it. The United States has already offered to make available $40 million, Canada has offered $5 million and Denmark $2 million. Other countries have pledged themselves to join the fund.

Past, present and future forestry activities of FAO were discussed by a Technical Committee on Forestry and Forest Products which met prior to the Conference.

A full report on the Committee's work will appear in the next issue of *Unasylva*. The Committee gave priority in the 1962-63 program to education training, followed by forest inventories, land use (including shifting cultivation, watershed management and grazing in forests, and other open land), development of forest industries (pulp and paper, sawmilling, plywood manufacture and other industries), logging, quick-growing tree species, and silviculture (including research on savanna forestry).

FIGURE 1. – *The foreman or* capitão *of a transect group directing his front cutters with the help of a Bezar compass. The men in front make the first opening in the underbrush of the forest.*

FIGURE 2. – *The survey team moving from one base camp to another makes use of river transport.*

Forest Survey in the Amazon Valley

D. Heinsdijk
FAO Technical Assistance Officer

The Brazilian Constitution lays down that 3 percent of the annual national income shall be made available for the development of the Amazon basin. The government agency which administers and supervises this development is the Superintendência do Plano de Valorização Econômica da Amazônia (SPVEA), with headquarters in Belém do Pará. Early in 1954, an FAO forestry mission started work in the Amazon valley in co-operation with SPVEA. The program of the mission was based on FAO Report No. 171 to the Government of Brazil on forest development in the Amazon valley, published in 1953. This report recommended the initiation of a forest inventory in selected areas, a recommendation which was accepted by the Brazilian Government and incorporated into the program of SPVEA. The surveys of all the areas initially selected will be completed in 1961.[1]

Reporting on a recent inspection tour to the Amazon area, the Deputy Director of the Forestry and Forest Products Division of FAO wrote: "As regards the forest reconnaissance survey, a large area south of the Amazon has been covered — the ground survey work involving some very tough expeditions into unexplored jungle far from the main Amazon river. As a result of this reconnaissance, there now exists a fair picture of what this enormous stretch of forest consists of, providing sufficient information to select areas which, by reason of their stocking or their relative accessibility, could, if funds permit, lead to exploitation and industrial development. For instance, three large areas have been provisionally selected as forest reserves suitable for exploitation; one on the Amazon itself, the second one on the Brasilia road to be developed in conjunction with a colonization project, and the third an area some distance west of the Brasilia road containing rich stands of mahogany. One of the important results of the reconnaissance survey has been the locating of hitherto unsuspected valuable mahogany forests lying to the south of the Amazon which form one of the great natural resources of Brazil... I found my visit to the Amazon an inspiring one because there is there a fine example of what practical types of work can be undertaken by FAO through the means of technical assistance, and I came away convinced that this work should go on and be developed to the maximum possible extent."

The forests of the Amazon valley cover an area of approximately 400 million hectares. The only possibility of undertaking a forest survey for an area of these dimensions is through the use of aerial photographs.

The only aerial photographs available for the Amazon valley are trimetrogon photographs taken by United States airmen during the second world war. Trimetrogon aerial photographs are mostly taken for reconnaissance purposes. Three cameras are used; one in the middle for vertical photographs and one on each side for oblique pictures. The three photographs, taken simultaneously, cover a surface area stretching from horizon to horizon at right angles to the directions in which the survey airplane is moving.

With such aerial photographs at hand, the best way to organize and execute a forest inventory is by means of an exploratory or reconnaissance survey (Figure 1). In the case of the Amazon the need was the more pressing since very little or no reliable data concerning the composition of the forests existed.

It was decided that a start would be made with the forests of the central part of the Amazon valley located close to the Amazon river (Figure 2) and its larger tributaries, which are navigable for seagoing vessels. This central part is estimated to extend over an area of approximately 100 million hectares. The aim of the survey was to obtain:

(*a*) basic data about the composition of these forests;

(*b*) a clear picture of the possibilities of penetrating the forests by way of the smaller rivers and/or by land;

(*c*) recommendations as to valuable or promising forest areas where coverage and more detailed surveys were warranted.

Confronting the task of surveying such vast forest areas and lacking information as to their composition, the first problem to be solved was where to start the survey. Based on the economic data provided by FAO Report No. 171 the forest area south and southeast of Santarém (halfway between Belém and Manaus along the Amazon river) was chosen. It later emerged that one of the most promising forest areas of the Amazon river was actually surveyed first; a fact which has emphasized the need for a preinvestment economic survey as a basis for planning a forest inventory program.

The survey was made in blocks, the blocks being given limits which are easily recognizable, mostly large rivers with familiar names. At present five blocks have been completed, of which four were surveyed under the direct supervision of the writer and one by B. B. Glerum. The five blocks cover an area of approximately 16,700,000 hectares. The following was the working method.

1. Planimetric base maps were made from the aerial photographs.
2. Forest samples were taken in the field.
3. The reports were prepared.

[1] D. Heinsdijk was assisted in these surveys by B. B. Glerum and G. Smit, who were appointed as assistant experts under an agreement between FAO and the Government of the Netherlands.

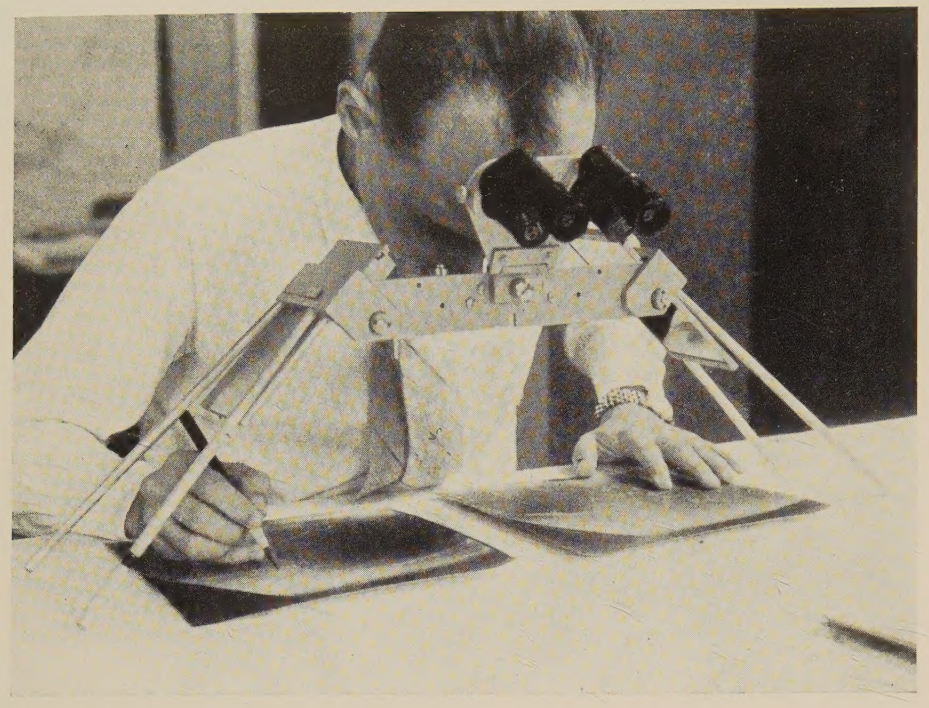


FIGURE 3. – *A draughtsman marking topographical features on oblique photographs.*

METHOD OF SURVEY

Mapping

It is not common practice and is also somewhat difficult to make detailed forest maps from trimetrogon aerial photographs. In using the aerial photographs made of the Amazon basin, there was one advantage, that is, the country is practically flat, with maximal differences in height of 150 meters in the *planalto* or plateau region; this enabled the oblique picture to be used. In country with high and steep hills or in mountainous country the hills and the mountains show their sides on the oblique pictures and conceal all that lies behind. The disadvantages were three in number.

1. The photographs, especially the oblique parts, were mostly clouded or hazy.
2. In some cases the adjoining flight runs were too far apart.
3. In the Amazon valley there are no astronomical stations for ground control, or other geodetic marking points which can be used for mapping purposes.

Strips of maps to the original scale of 1:40,000 were made from the verticals of the trimetrogon flight runs, the strips fitted in as well as possible in between the astronomic station — or other geodetic marking points. These map strips were transferred to 15 minute square base maps; and on these base maps the tie-in points for the obliques of the adjoining (or crossing) flight runs were marked. Using a mirror stereoscope the details seen on the oblique photographs were traced in red pencil and transferred to the base maps with the help of an oblique sketchmaster. Based on observations made in the field, the necessary corrections were adjusted on these base maps and thereafter finished in colored ink (Figure 3).

In view of the limited accuracy of these maps, they were photographed on a scale 1:200,000, traced to that scale and joined block by block into one final map. These final maps do not pretend to have a high degree of accuracy, but they do present an excellent over-all picture of the country surveyed. Copies of these final maps have been included in various FAO reports (Nos. 601, 949 and 992) to the Government of Brazil.

From the verticals of the trimetrogon flight runs, apart from the usual topographical features of the country, such as roads, villages, rivers, etc., the borders of grass, scrub and forest vegetation growing on permanently or temporary waterlogged soil or on dry land, could easily be mapped. This was not always so easy along the borders of the oblique pictures (found around the center of the photograph) but, assisted by field observations, these areas could also be drawn with fair accuracy.

Up to now only the *terra firma* or dry land forests have been surveyed. Close to the mouth of the Tocantins river and near and on the isles of Marajó *várzea* or swamp forest was seen which may possibly be of value; its extent justifies a special survey. It has not yet been possible to start this survey. Every effort was made to divide the dry land forests to be surveyed into types by means of pure photo-interpretation to facilitate the sampling procedure. Without first visiting these forests it was easy to map the patches of secondary forest and the savanna or *caatinga* forests. The latter are low forests with only one tree story; the trees are very close together with small crowns, and are mostly less than 10 meters in diameter, growing more or less to one level. These forests can easily be discerned

from the surrounding high forest by their smooth and level crown canopy, which appears as a whitish color on the aerial photographs. On the oblique parts their limits could also be traced without too much difficulty.

The composition of dry land forests surveyed up to the present may be described as very uniform. There are changes in composition but these are mostly gradual changes, never such abrupt changes as between hardwood and softwood forests in the temperate zone. The differences between two adjoining forest types were mostly caused by one or two tree species or were merely different in the abundance of certain species.

This uniformity can best be explained by an example. FAO Reports Nos. 969 and 992 each contain a field record of the enumeration of samples. These two sampling units were taken at random from the records on which the reports were based; they are located 1,200 kilometers apart, one near the Rio Madeira and one south of Belém. In the first sampling unit 60 species and 111 trees were enumerated, and in the second sampling unit, 42 species and 133 trees. The two sampling units had 22 species in common, comprising 53 trees of the first unit and 75 trees of the second unit: that is, more than half of the trees enumerated in these two sampling units belong to the same species. If all indications of place and time were lost from these records, the only possibility of relocating them would be by two tree species, i.e., pau amarelo for the sampling unit near Belém and momorana or castanha do pacá for the sampling unit near the Rio Madeira, because pau amarelo was only enumerated near Belém and momorana or castanha do pacá only near the Rio Madeira.

The crown canopies of these forests appear very uniform on the aerial photographs. With sufficient experience both high and low forests can be mapped from the photographs as also can those forests with high and low gross volume; the latter has to be done with the help of crown counts. Low patches in between high forest are not necessarily an indication of change in forest type; they are more often old windfall areas where the forest is growing again to fill the gaps. In practice, the only real forest type mapping from the aerial photographs could be done in *planalto* or plateau regions where the forest types followed more or less the topography of the country. The other forest type mapping was based on the samples taken in the field and their limits are all more or less roughly drawn.

Sampling units

The aim of an exploratory survey is to obtain information about the nature of the forests under investigation, particularly its variability both as a whole and within and between the various forest types found. To realize this aim in the Amazon valley, survey groups penetrated the area under survey as far as possible and took a sample from the *terra firma* or dry land forests; within the sample the sampling units covered the forest more or less systematically. The sampling units were taken along transects which were always projected perpendicular to the topography of the country, according to a prearranged plan. Owing to the quality of the aerial photographs and the lack of a good geodetic base for the maps, a transect sometimes coincided with a river or ran parallel with the topography of the country, since the planned direction of the transects could not be changed. However, these were rare exceptions; the transects were mostly well located, with errors in direction of only some degrees. The sampling units were practically all 1 hectare in size; all trees with a DBH (diameter at breast height) of 25 centimeters and more were enumerated 5 meters left and right from the center of the transect over a length of 1 kilometer (1,000 × 10 meters = 10,000 square meters or 1 hectare). The identification of the tree species was supervised and checked up by Dr. Ricardo Lemos Froes and personnel from the Botanical Department of the Instituto Agronômico do Norte in Belém do Pará.

The most difficult part of the survey was the organization of field trips. From the operational bases at Santarem or Belém, practically all transportation was by boat on the large rivers, with launches of 15 to 45 tons, additional transportation being by big canoes with outboard motors or with small canoes for the smaller rivers and creeks which are mostly impossible to navigate for larger vessels because of fallen trees.

A survey party spends the duration of the survey trip, from 30 to 40 days, on its own in the Amazon forests with, as a rule, very little or no communication with the outside world. The paragraphs below give an idea of such a field party, its members and their duties.

Personnel of the survey party

1. *Staff*

(*a*) *Chief of the survey party*, who is responsible for the proper execution of the sampling work. With the help of his assistants he enumerates most of the sampling units.

(*b*) *One or two assistants*, being trained to take over the duties of chief of a survey party.

(*c*) *Calculator*, who makes the enumerations and calculations of the sampling units taken during the trip, so as to enable the chief to spot at once particular changes in composition of the forest surveyed. As more than 300 tree species, from which 100 are more or less commonly found, may be dealt with, careful study of the records is needed in order to analyze composition. The calculator is also trained in photo-interpretation and had to be able to enumerate a sampling unit.

(*d*) *Botanist*, who works in close co-operation with the tree namer from the enumeration party. He collects botanical material, which is dried and prepared for transportation in a special shelter in the main camp.

2. *Two transects groups*

The groups of laborers who cut the transects consisted of the following personnel:

(*a*) *Foreman or "capitão,"* responsible for the transect cutting of his group (which is selected by himself). With the help of a Bézar compass he keeps his line cutters in the proper direction.

(*b*) *Two front cutters,* who cut through the underbrush of the forest in front of the foreman, who controls the direction in which they proceed.

(*c*) *Two chain men,* who follow directly after the foreman and measure the length of the transect with a chain of 20 meters. After each chain a stick is placed in the ground and after every two chains, i.e., every 40 meters, a number put on the stick. As the scale of the vertical photographs and the base maps is 1:40,000, the number on the stick therefore represents the length of the transect in millimeters if put on the base maps. This is a simple way of recording topographical features of the country encountered along the transects.

(*d*) *Six transect cleaners,* who make a clear footpath in the center of the transect (all small stumps are cut and detours made only for very marshy places) with temporary bridges (with a handrail) for inundated forest areas, rivers or creeks. These paths can be walked at an average speed of 4 kilometers per hour. In an emergency a speed of 7 ½ kilometers per hour was made.

3. *Enumeration group*

Apart from the survey chief, his assistants and the botanist, this group consists of:

(*a*) *Tree namer,* who is usually an older man who has spent his life in the forest, either as a forest worker or as a hunter. He identifies the tree species by cutting the bark. As a rule this is sufficient, otherwise the wood is cut or fruits and leaves are sought. It is difficult to find a good tree namer, but the good ones, who have passed the botanist's examinations, seldom make a mistake as long as they work in their own region.

(*b*) *Tree namer's assistant,* who carries a 5-meter bamboo pole and with it indicates the trees which belong to the sampling unit, 5 meters left and right from the center of the transect. There may be a few cases where the survey chief has to decide if a tree is in or out of the sampling unit, that is, in cases where it is a question of 10 centimeters more or 10 centimeters less; this usually occurs for less than one tree per sampling unit. When the tree namer has measured the circumference, his assistant puts the bamboo pole against the tree to facilitate the estimation of the height made by the surveyor.

(*c*) *Tree climber,* who is a specialist trained in climbing trees with the help of climbing equipment (as used in climbing wooden telephone or light poles). On every sampling unit he climbs at least three trees and measures the length of the merchantable bole with a measuring tape in order to give the surveyor the opportunity to check his height estimates. At the same time, the circumference at the end and in the middle of the merchantable bole is measured; this data being used for the construction of volume tables. He also helps the botanist in collecting material from the standing trees (Figure 4).

(*d*) *Botanist's assistant,* who cuts down trees for the botanist and carries the material gathered.

4. *Camp personnel*

This section consists of the following persons:

(*a*) *Cook,* who is also in charge of the storeroom and material. With the calculator he is also responsible for the medical care of the party.

(*b*) *Cook's helper,* who does most of the very simple cooking.

(*c*) *Professional hunter,* whose task is to provide the party with fresh meat. If he is unlucky or game is scarce, some of the cleaners of the transect groups assist him.

5. *Transport group*

This group is in charge of all transportation by water and looks after the boats and motors. It consists of the personnel of the launch, that is, the captain and his assistant, the engineer and his assistant, and a pilot. A pilot is needed practically everywhere since most of the traveling by launch is at night.

Size and method of travel of a survey party

The total personnel of a survey party is usually about 40 although, when soil surveyors or visitors are added, it can be even more. However, in order to have the work done on time and to keep the party moving smoothly, 40 people can be regarded as a maximum. Otherwise, bigger launches are needed, which have the disadvantage that they cannot enter the smaller rivers and in consequence handicap the mobility of the party. Only during travel by launch does the party live on board. On arrival at the approximate center of a group of planned transects a good campsite is selected and a camp is erected with open shelters by using heavy 5 × 5 meter tarpaulins. The time needed to reach the transect furthest away down or upstream from the camp may not take more than one hour by launch or canoe with or without an outboard motor. A camp usually consists of 10 to 12 tents, washing places, mess tables, kitchen, etc. Including campsite clearing,

a camp can be set up in four to eight hours and broken up in one hour.

In the Amazon valley, field trips were made throughout the year. Especially during the rainy season, when the water in the smaller rivers and creeks is high, it was much easier to work than in the dry season since the forest could be penetrated better along the waterways. During the 1,149 travel days spent by the survey parties in sampling the five blocks, only five working days were lost through heavy rains.

Planning the sampling procedure

The planning of the sampling procedure for an exploratory survey has its particular difficulties. That the degree of variability of the forests surveyed is not known, cannot be regarded as a handicap or a difficulty since to measure this variability is one of the aims of this kind of survey. The real handicap in some cases may be that no forest type mapping can be done from the aerial photographs before going into the field, so the limits of the forest types inside the dry land forest formation to be surveyed are unknown.

The enumeration of a sampling unit starting directly from the point of entrance into an unknown forest type of this sample unit will be unbiased but, if a second is taken without a prearranged plan, it can be biased. Therefore, the location of the transects to be cut, along which transects the sampling units are to be taken, is planned and put on a provisional map or on aerial photographs. The standard length of the transects was usually 10 kilometers, from which the third, the sixth and the tenth kilometer were enumerated. In some occasions these transects were extended up to 27 kilometers with a subcamp in the middle, and sometimes they were only 6 kilometers long.

The sampling units were taken along these longer or shorter transects in the same sequence. This sequence is based on practical experience. An enumeration party can enumerate two sampling units of one hectare per day along a transect, if they have only to walk 12 kilometers (6 going and 6 coming back) and one sampling unit of one hectare per day if they have to walk 20 kilometers (10 going and 10 coming back). The transects were projected along the rivers and creeks navigable for launches or big canoes with outboard motors.

An attempt was made to get the same number of sampling units in the square of 15 minutes represented by the base maps, but this proved very difficult. In the *planalto* or plateau region the smaller rivers were very difficult to enter and on top of the plateau there was no water, so it was almost impossible to make subcamps. South of Belém it often happened that the virgin dry land forest was found to have been cut away because the trimetrogon photographs dated from 1942-1944 and since then the population around Belém had increased substantially. On two occasion Indians would not permit the survey parties to enter the forests.

In view of the uniformity of these forests and the experience gathered during the survey of the first block, that is, of the Rio Tapajóz-Rio Xingu region, fewer samples were taken in the other blocks. In the first block approximately 0.03 percent of the dry land forests was enumerated; in the others approximately 0.006 percent.

FIGURE 4. – *A tree climber starting to climb a tree adjusts the measuring tape on his belt. With this are measured the exact length of the merchantable bole, the circumference at the top and at the middle of the bole.*

Analyses of composition for all the forests surveyed were made per forest type. All species found in the sampling area were put into presence classes. A species in presence class 100-90 percent meant that this species was found on 100-90 percent of the number of sampling units taken in that type, etc. From each type frequency curves (*curva de frequência das espécies*) were made. The sampling units with their numbers appear on the x-axis of this curve, the number of species on the y-axis.

The number of species found in sampling unit No. 1 is indicated above this sample (in the reproduction given in Figure 5, it is 52); the number of tree species found in the sampling unit No. 2 (in the reproduction given it is 84), etc. Above the last sampling unit can be

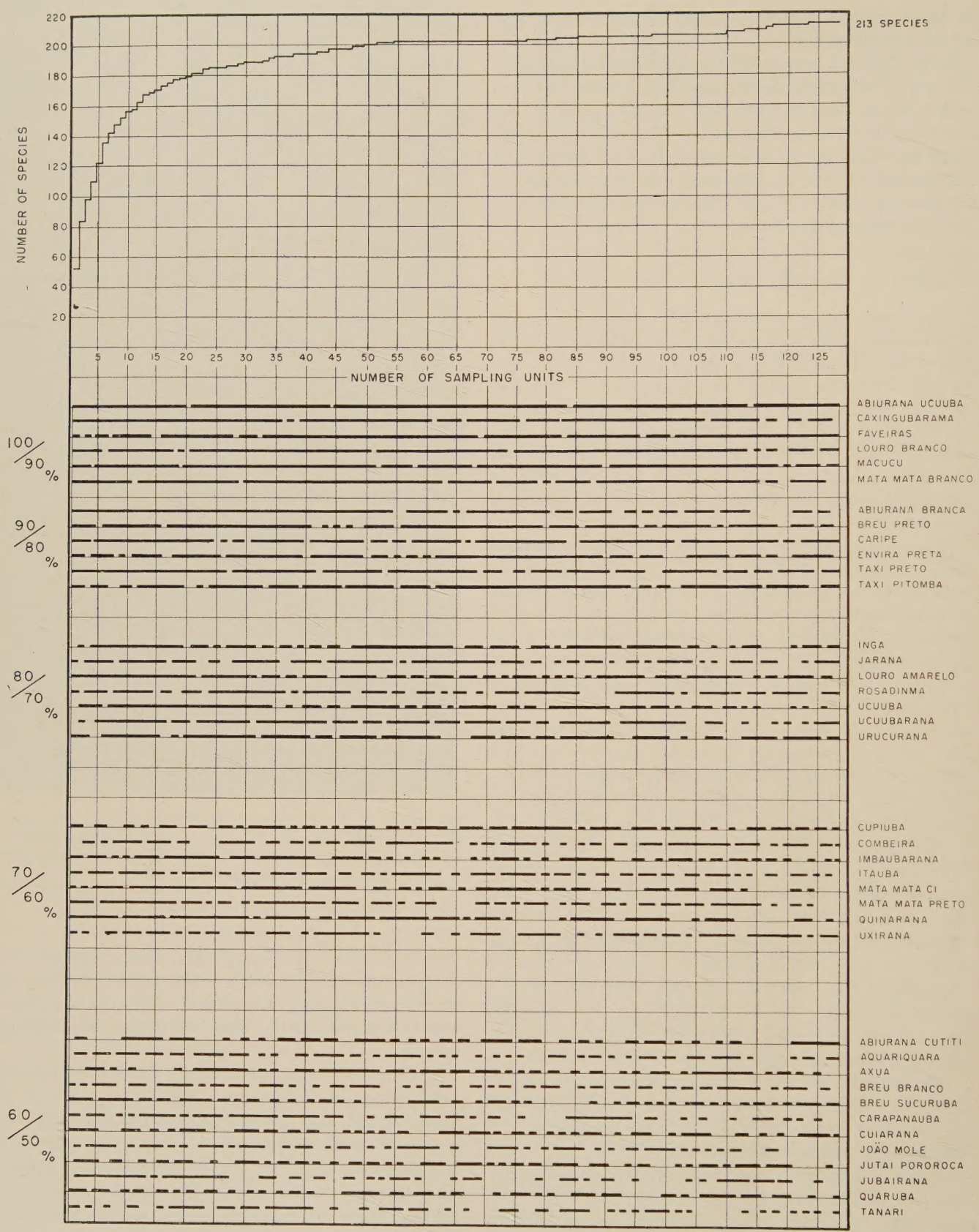


FIGURE 5. – *Frequency curve for the tree species found in a forest type (FAO Report No. 969, Maues type). For this survey 128 sampling units, each of one hectare, were selected. Averages of 117 trees and 169.4 cubic meters of timber were found. On the diagram above sampling unit No. 1 is given the number of species found in that unit; above sampling unit No. 2 is given the number of species found in sampling units Nos. 1 and 2, etc. When a species is found in one of the sampling units it is indicated in black. From the lower part of the diagram it can easily be ascertained whether a species occurs only in a part of the forest type surveyed or is spread out regularly through that type.*

found the total number of tree species enumerated in the sampling units (in the reproduction given it is 213). In all the forest types sampled the majority of the large number of species occurring were already recorded up to sampling units No. 10-15, while in later units only a few additional species were found that had not already been enumerated in this first 10-15. The inference is that one can readily record the commonly and frequently occurring tree species for these forest types from 15 sampling units.

For the purpose of analyzing whether these tree species were distributed regularly over the sampling units, and so consequently also throughout the forest types surveyed, the species found in the presence classes 100-90 percent, 90-80 percent, 80-70 percent, 70-60 percent and 60-50 percent were given below the frequency curves with an indication in black if found only in a certain sampling unit, named with its number on the x-axis of the frequency curve. This was done to ascertain what species of these presence classes were only enumerated in certain parts of the forest types and could therefore indicate a possible change in composition, as being the indicators or dominant tree species.

Variability of forest types

The next aim of the exploratory survey was to obtain data about the variability of the forest types found. In Belém (where there was no possibility of using punched cards for statistical analyses) every effort was made to get a clear picture of this variability, but after a number of trials with a few sampling units, it became clear that a thorough statistical analysis was needed of as many sampling units as possible, spread out over large forest areas.

After having obtained 918 sampling units of one hectare, the results were sent to the Statistics Department of the Central Organization for Applied Scientific Research in the Netherlands (TNO). This organization was asked if (*a*) single tree species, (*b*) some given groups of three species, and (*c*) the total number of species per hectare occurred according to the Poisson distribution formula, i.e., at random, and how many sampling units would have to be taken in these forest types to obtain an accuracy of 10 percent in respect of the numbers of trees and their volume of merchantable timber, allowing an error of plus or minus 5 percent (actually with a chance of 95.44 out of 100 of being correct). The Poisson distribution formula was used because it deals with the occurrence of isolated instances (the appearance of a single tree) in a continuance of area.

From the calculations made by TNO it appeared that the distribution of the tree species did, in general, follow a Poisson distribution, but that there were often exceptions where sampling units showed a high number of particular species indicating aggregation or colony forming. In fact, this is one of the most significant findings of these exploratory surveys and explains some features of the nature of the Amazon forests.

In other words, the sampling results showed clearly that practically all tree species were distributed at random but that where the circumstances were particularly favorable for certain species and improved their competitive power in relation to the other species, there was a tendency to aggregation or colony forming. This can only mean that individual tree species of the Amazon forests have the ability to dominate these mixed forests under certain circumstances and very probably have also the ability to form pure stands. Some species dominated large tracts of the understory and others, here and there, the upper story of the forest types sampled.

More Detailed Forest Inventories

When a tree species is distributed according to a Poisson distribution or at random, and a 10 percent accuracy in sampling is required with a possible error of 5 percent, it is necessary to enumerate 400 trees of that tree species.[2]

Tables have been worked out from the presence class data obtained, which enable estimates to be made of the extent in hectares of the sampling required to record this number of trees.

The forester experienced in this kind of work in tropical forests, far from populated centers, would probably regard such surveys with individual species in mind as being very complicated and not very practical. But two examples may be given where more detailed forest surveys have value.

Leasing blocks of government-owned forests

If one of the states in the Amazon valley wants to lease parts of its forests for exploitation in blocks of 10,000 or 20,000 hectares, it would be worthwhile to carry out more detailed forest inventories in a number of such blocks to enable comparisons to be made and hence the proper conditions for the leases. Interest will be not in single tree species but in groups of tree species of current economic value (in the FAO reports referred to previously, several such groups of trees are mentioned).

The number of sampling units of 1 hectare needed to perform more detailed surveys to obtain the volume of standing merchantable timber for such a group can be taken with a large safety margin as 200. This means that for a block of 10,000 hectares, a 2 percent survey is needed and for a block of 20,000 hectares a 1 percent survey.

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[2] $O : Op\,x = \frac{t\sqrt{\text{variance}}}{\sqrt{n}}$ in which 'p' is percentage, 't' a probability factor, 'x' average number of trees per sampling unit and 'n' the number of sampling units. One of the characteristics of the Poisson distribution is that '$\bar{x}$' or the sampling average is equal to the variance. When 10 percent is substituted for p; 2 for t, being the approximate value for a possible 15 percent chance of making a mistake, and for variance: $\bar{x}$ or the sampling average, the formula $n = \frac{400}{\bar{x}}$ or $n.\,\bar{x} = 400$ trees is obtained.

Commercial exploitation

For a commercial firm wishing to exploit a limited number of species, for example, cedro (*Cedrela odorata*) and freijo (*Cordia geoldiana*) or pau amarelo (*Euxylophora paraensis*), acapu (*Vouacapoua americana*) and sucupira (*Bowdichia nitida*), it is possible to indicate in the regions covered by the exploratory surveys the forest types where the greatest volume of standing timber of these species per hectare can be found. Provided this volume per hectare and all other circumstances make commercial exploitation appear a reasonable proposition, the company will be prepared to finance a closer inspection of the selected areas, particularly for working out the extraction plan and costs.

A practical solution in, for instance the case of cedros and freijos is to select at random 40 squares of 1 × 1 kilometer and enumerate in these squares all trees of these species. With four good (local) forest workers and a surveyor, one square can be done in one to one and a half days (depending on the undergrowth). The other species require other variations.

TABLE 1. – NUMBER AND SIZE OF THE PARTS OF THE SQUARES OF 1 × 1 KILOMETER WHICH HAVE TO BE SURVEYED TO OBTAIN DATA ABOUT AT LEAST 400 TREES OF A TREE SPECIES BELONGING TO A CERTAIN PRESENCE CLASS

Presence class	Size of sample in ha given with a high degree of accuracy	Number and size of sampling units to be selected at random		Extra transects needed per sampling unit
percent		*number*	*kilometers*	*kilometers*
10–20	4 000	40	1.0 × 1.0	—
20–30	2 000	40	0.5 × 1.0	1.0
30–40	1 200	40	0.3 × 1.0	2.0
40–50	800	40	0.2 × 1.0	2.0
50–60	600	40	0.15 × 1.0	2.0
60–70	500	40	0.125 × 1.0	2.0
70–80	400	40	0.100 × 1.0	2.0
80–90	300	40	0.075 × 1.0	2.0

It is very probable that following the indications given in Table 1, more than 400 trees of a given species will be enumerated, so the accuracy in estimate of volume of standing merchantable timber will also be high. It is recommended that a survey should be made of all trees of the species under investigation from DBH 25 centimeters up, even though most probably exploitation will be limited to trees with a DBH of 50 or 60 centimeters.

COSTS OF THE SURVEYS

At the time these exploratory surveys were started the exchange rate of the Brazilian cruzeiro was 60 to the US dollar. This rate rose at one time to 160 and is at the time of writing between 130 and 140 to the US dollar. Simultaneously the cost of living has gone up substantially.

The actual costs of all the work carried out in the Amazon are known, and have been converted into terms of travel days and sampling percentages. Taking the survey of an area of 3.5 million hectares as normal for one survey group per year, the costs of the groups were between 284 and 53 cruzeiros [3] per square kilometer of area mapped and between 379 and 76 cruzeiros per square kilometer of dry land forest surveyed. Including salaries of the whole team, material, photographs, reports, etc., costs were between 341 and 110 per square kilometer for the whole area mapped and between 450 and 147 for the dry land forests surveyed.

It is difficult to express a reasonable average of costs per hectare for this kind of survey, because the sampling percentage varies with the degree of uniformity of the forests under survey. But in terms of US dollars costs may be put at 1 to 4 cents [4] per hectare of dry land forest surveyed. This does not include the cost of aerial survey since existing aerial photographs were used.

The costs of a more detailed survey are estimated at 60 US cents per hectare which is high and would not be justified except on an area where the reconnaissance survey had indicated that exploitation was indeed worthwhile. The surveys carried out by the FAO mission have in fact already given sufficient indications as to where precisely further forest investment is a safe proposition.

[3] The upper limits are for the first block with the highest sampling percentage and the lower limits for the area close to Belém where the least time was lost in travel to and from the forests.

[4] 135 cruzeiros = US $1.00.

CORRECTION

In the article "Some problems of regional planning in forestry" in *Unasylva*, Volume 15, No. 2, on page 85, Figure 3 and Table 2, instead of "district f, sphere *IX*" read "district f, sphere *VIII*."

The Electronic Digital Computer in Forestry

J.N.R. Jeffers
Forestry Commission, United Kingdom

Since the last Congress of the International Union of Forest Research Organisations (IUFRO),[1] one of the notable developments in forest research and management has been the increased use of electronic digital computers. Indeed, it is no exaggeration to say that this development has completely transformed the scientific background against which these congresses are held. For the first time in the history of man it is now possible to make an attack on some of the problems which underlie our fundamental knowledge of forestry, and many of our existing techniques have been outdated by the more powerful mathematical tools that have been made possible by the computer. These developments affect the work of all sections of IUFRO, but it is particularly appropriate that Section 25 should take and lead in promoting the wider use of the electronic computer in forest research, for it is this section whose work has been most affected, and most rendered obsolete, by the new machines.

This paper is intended to provide a brief description of electronic digital computers, review the present situation of their application in forest research, and to make recommendations for their more effective use in the period up to the next congress.

Electronic digital computers

The electronic digital computer is a machine which is characterized by the ability to store numerical information, and to carry out arithmetic and logical processes on this information by obeying a sequence of instructions also stored within the machine. The word "digital" indicates that the form in which the computer stores and manipulates the information is closely akin to that by which we have become accustomed to handling numerical information, that is as a series of digits. This is in contrast to certain other types of computers which are able to store and manipulate numerical information in the form of physical quantities, for example, as electrical potentials or resistances.

The sequence of stored instructions by which the computer is controlled is called a program, and these instructions are specially written for each problem that the computer is called upon to undertake. By means of these programs, the computer can be made to perform any desired mathematical operation or logical process quickly and efficiently. The effort of programing can be further reduced by taking care to generalize the procedures in the solution of individual problems so that the resulting programs can be used for a number of separate applications.

It is the speed at which the computer is able to obey the sequence of instructions in order to follow through a particular computation, and the accuracy of the calculations even at these very high speeds, which constitute the main advantages in using electronic computers as opposed to other forms of calculating machines. A further advantage, however, lies in the fact that once the program has been prepared for a particular computation, the computer will obey the sequence of instructions faithfully, without deviation, and any number of similar computations can then be made without expert supervision. In this way, a small number of experts can undertake a vast program of research, without fear that their instructions may be misinterpreted in the handling of the information.

Even in the period between the two congresses of IUFRO, there have been further developments of the computers themselves, and modern computers are more reliable, less expensive, and require less maintenance, thanks largely to the replacement of valves by transistors in the electronic circuitry of the machines. The modern machines are also very much easier to program, that is, the language by which the user communicates with the machine is simpler to understand and to write, and, today, there is no-one reading this paper who would be unable to program a modern computer to carry out computations which he thoroughly understands.

There are of course a very large number of different types of electronic digital computers, differing mainly in the amount of information which they are capable of storing and in the medium used to transfer information into and out of the machine. The differences in the engineering techniques by which the various processes are carried out, though of interest to the electronics engineer and physicist, are less important to the forester. The speeds of individual machines also differ considerably although, here again, the most important difference is the change from the very slow computing speed of electric desk calculators to the entirely different order of speed made possible by the electronic computer and, for most forestry applications, differences in speed within the order obtained by modern machines will not be of great significance. The differences in the amounts of information that can be stored are perhaps slightly more important, although there are few existing machines that are too small for use in forestry research,

[1] Paper presented at the IUFRO Congress, Vienna, September 1961.

and most computers have a greater capacity than is required for the majority of forestry purposes.

The differences in the medium used for the transfer of information into and out of the computer are very much more important for the practical user. Many computers were designed to take advantage of the earlier development of conventional punched card machines, and have therefore been designed to take advantage of existing equipment for preparing, sorting and tabulating punched cards as a method of translating information to be read into and out of the computer, and for reading the results produced by the computer. The punched card becomes the input and output medium for these computers. Other machines have been based on input and output techniques which are dependent on punched paper tape, using five-, seven- or eight-hole teleprinter tape, and such machines have the advantage that the machinery for the preparation and reading of tape are considerably cheaper than those for handling punched cards. Both punched cards and punched paper tape, although very fast by conventional standards, have been found to limit the speed of the computer, and most modern electronic computers offer an alternative, and very much faster, medium in the form of magnetic tape or magnetic film.

Use of computers by forest research organizations

In March 1960, the President of IUFRO carried out a survey by correspondence of the use that was being made of electronic digital computers by forest research organizations. The results of this survey indicated that extensive use of electronic computers was taking place in Australia, Canada, Sweden, Switzerland, the United Kingdom, the United States, and that less extensive use was being made of these machines in Japan, the Netherlands and New Zealand. Valuable experience in the application of computers was therefore being gained in all these countries. Rather surprisingly, many organizations stated categorically that they were not interested in the application of electronic computers to problems of forest research, and some were clearly confused between computing methods based on punched cards and electric desk machines and those based on electronic digital computers. While it was expected that forest research organizations in countries in which electronic computers were being actively developed would be the ones most aware of their possibilities, and the ones which would have easiest access to computers, it was not expected that so many organizations would have been unaware of the possible economies in the use of these machines.

It should perhaps be stressed at this point that the computer is of the greatest importance in those countries which have only a small reserve of trained scientific staff, as it relieves this small body of experts of the tedium of calculation and routine handling of information, and enables them to devote their energies to more worthwhile matters.

Applications of electronic computers in forestry

In countries making extensive use of electronic computers in forest research, the first applications of these machines were very naturally concerned with the speeding up of computations which were already being undertaken by other means. Examples of this class of computation are given by the calculations involved in large-scale forest enumerations, in the construction of yield tables and volume tables, and in the mathematical analysis of designed experiments and surveys.

In all of these applications, little advantage was taken of the basic properties of the computers, except that of the speed of calculations, and the form of the calculations was little different from that which would have been used by more conventional computing aids. Later, however, it became apparent that the most important use of computers was in their extension to types of computation that had never before been attempted, not merely because they would take too long, but also because they were too complex to be handled by the conventional computing machines. Examples of these calculations are multivariate analysis of complex problems, such as the effects of site on choice of species and on growth, of the relative values of physical properties of timber in assessing its quality, of taxonomy of plants and animals important in forestry, and of crop-weather relationship. Other applications of this kind include the building of mathematical models to simulate practical problems, as in the various techniques known as operational research, e.g., Monte-Carlo methods, linear programing, the queue theory, and the theory of games.

The present phase of the advanced use of the electronic computer in forest research is in the greater exploitation of the basic processes and principles of the computer, in the ability to sort, store, and handle information rapidly and in new ways, as opposed to the substitution of these processes for the more usual and slower methods in previously elaborated theories. These developments will undoubtedly lead to entirely new methods of forest research, exploiting computer techniques to the full, and based on completely automatic data processing systems.

International library of programs

As more and more forest research organizations come to use electronic computers, the stock of programs for computations of interest to foresters will increase rapidly. To avoid waste of time in duplicating work that has already been done, therefore, and to make available the work of any individual organization to the widest possible field of application, it will be desirable to arrange for the interchange of the basic programs that are written. There are however a number of difficulties. First, different machines use different order codes or languages for their programing and, even among the machines made by the same manufacturer, there is frequently no common language between the machines.

On the international scale, the problem is further aggravated by the fact that the persons writing the programs do not speak the same language.

In the United States, there has been some success among a certain range of computers in the use of a common language, capable of being obeyed by a number of machines, and known as "Fortran," and this common language between machines may well help to solve the worst of the problems of the communication of computer programs for that continent. In Europe, an alternative common language between machines is being pioneered, that of "Algol." It is too soon to say whether or not this language will be as successful as "Fortran" has been in the United States, but it may well enable programs to be interchangeable on a wide range of future machines, if not on those already existing.

In the light of this difficulty, perhaps the best that can be done to avoid duplication of effort is to keep a register of existing programs, and to revise this register as new programs are developed. The register should record the existence of the program, stating exactly what it does, and the form in which the data have to be provided. The computer or range of computers for which the program is immediately suitable, i.e., can be run without modification, would also be recorded. To enable the program to be run on other machines, a full "flow-diagram" giving the stages of the computation, and the order in which the individual stages are entered would be given, so that programers for other machines could reproduce the calculation in the shortest possible time on their own computers.

In addition to the library of existing programs, it would also be desirable to maintain an index of those organizations and individuals who are actively using computers, and particularly those which have computing time to spare, and which would be prepared to take on computing work for other organizations on repayment. Although it will probably always be possible to have such computations done by nonforestry organizations, or by commercial computer firms, experience has shown that there are many advantages in having forestry calculations done by organizations that are also concerned with forestry.

In the absence of any permanent secretariat for IUFRO, the library of existing programs of interest to foresters, and the index of available computer time, might be maintained by the Advisory Group of Forest Statisticians, or by persons co-opted by them. Each member of this group might take particular responsibility for the knowledge of the facilities available in his region, and would therefore be the person to be approached in the first place. The distribution of the members of the group is, of course, very suitable for this purpose.

Further developments

In the years between the present congress and the next congress, there will be many developments in the field of electronic computers, and in their application to problems of forest research and management. The use by forest research organizations of computer facilities existing in other organizations is essentially a temporary phase and, in a very few years' time, many forest research organizations will have their own electronic computers, and will have developed advanced methods of research based on modern data processing and computer techniques.

There is no substitute for foresters themselves becoming involved in this process, and for foresters themselves learning to program the machines, if the best possible use is to be made of the exciting and almost unlimited possibilities which these machines have disclosed. Actual programing is the only constructive way of becoming familiar with the machines and their possibilities, and it is important that the realization of what these possibilities are should be spread to the largest possible number of foresters. The author of this paper believes that so powerful an apparatus has never before been placed in the hands of the forester to enable him to fulfill his part in the great project for the preservation and rational utilization of the world's forests. The danger is rather that the electronic computer will be ignored in forestry rather than misused.

Recommendations

It is recommended:

1. that the congress should take note of the important development of electronic digital computers, and their application to problems of forest research;
2. that the member organizations of IUFRO should be encouraged to carry out research into the application of these machines to their problems;
3. that a register of existing computer programs of interest to foresters, and an index of organizations and individuals actively using computers, should be maintained by the Advisory Group of Forest Statisticians, and that this group should be asked to consider how this might best be done;
4. that a meeting to discuss the experience gained in the use of computers in forestry research and management should be held at the next Congress of the International Union of Forest Research Organizations, under the auspices of Section 25, but open to the members of all sections.

National Forestry Funds

R. G. Fontaine
Forestry and Forest Products Division, FAO

The 1960 FAO Regional Conference for Europe gave attention to the need for and desirability of national forestry funds. It concluded that "the formation of such a fund may be necessary since afforestation can only be a long-term investment, requiring continuity of plan, and private investment cannot always provide sufficient capital or use the proper methods. The matter deserves further investigation and should be put on the agenda of the 1961 session of the European Forestry Commission." This note was drafted as a basis for the Commission's discussions.

Outlays on forestry work can be divided into current and capital formation expenditure. The former is for the purpose of conserving stands as productive capital through normal management, while the latter aims at improving the quality and quantity of forest products, and covers forest extension and the planting of quick-growing species outside the forest; the improvement, restoration or conversion of existing stands; financing the equipment and protection of forest stands; and making them more accessible by road construction.

The financing of current expenditure usually raises no problems. Receipts from the sale of products of privately-owned stands or appropriations out of the annual budget for state or community forests usually provide the means. In some cases, however, particularly in connection with inherited stands, the State helps private owners either by exempting them from taxes or with loans.

In some countries, moreover, outlay on maintenance is obligatory. This is true, for instance, when it is a question of restocking cutover stands in Austria, Western Germany, Italy and Portugal. In Norway, some of the logging receipts are paid into a special account which the owner can draw on only when he has given proof that he has carried out certain regeneration or improvement work. In Italy and Spain, part of the receipts from sales of timber from public community stands is automatically channeled into stand improvement and protection work.

On the other hand, capital formation expenditure sometimes raises certain difficulties. In fact, what is involved is either work such as normal reforestation that gives practically no returns or which yields them only after a long period of time and therefore does not attract capital; or work requiring a large initial capital outlay beyond the means of private individuals, for instance the planting of quick-growing species or infrastructural work; or finally, work that would be of benefit not to the person financing it but to the community at large and which therefore is in the public interest. This is the case, for example, with the planting of forests for protection purposes, to afford recreational facilities or, in countries that are net importers, to supply the nation with timber in the case of emergency.

In most countries capital formation expenditure is financed from the annual state budget for work in the public domain and by private owners themselves for their own stands. However, very often private owners receive state help in the form of low-interest loans or subsidies from the annual state budget. In general, in the case of works in the public interest that offer small returns, the State is called upon to intervene, whether the land be publicly or privately owned.

Work carried out with public funds has usually been limited in scope because the necessary fund allocations depended on budgetary availabilities. An attempt has been made to overcome the drawbacks connected with an annual budget by a number of systems, for instance:

(*a*) by earmarking budgetary receipts to provide the necessary funds, under a special law, fixing a proportion of receipts from an existing tax;

(*b*) by programing laws that initially stipulate the exact amount of outlay necessary for executing any project and spreading expenditure according to a commitments-and-payments schedule;

(*c*) by special development budgets; and

(*d*) by economic development funds that are independent of the state budget.

Such measures, however, give only relative security if the requirements of the state treasury for one reason or another absorb all or part of the receipts that were initially intended for forestry work. In the case of laws programing forestry work, in countries with a parliamentary government, commitments are usually limited in duration to the period of office of the legislative body, and are inadequate for long-term projects.

For state forests the formula of independent departments has very often been adopted. These can be financed in many ways, in particular from income derived from the forests themselves. Outlays for state forests are given first priority. However, if after several years of functioning there is a surplus in these funds, part of it may be paid into the state treasury. If, on the other hand, there is a deficit of receipts from the stands such that expenses cannot be covered, as happens with poorly forested countries, other sources of credit must be found.

In the last few decades, particularly following the second world war, these methods of financing have proved inadequate because in many European countries regeneration of stands has required heavy and continuous outlay.

Forest extension and rehabilitation require particularly large investment. The European Forestry Commission has several times emphasized the need for large-scale afforestation in order to supply anticipated future needs. It also recognized that the physical and social role of forests can only be fulfilled if forest extension and rehabilitation work is carried out on a large enough scale. For the Mediterranean region, the FAO Mediterranean Development Project demonstrated not only the need for large-scale afforestation work, mainly with quick-growing species on the plains in order to supply a growing timber demand, but also the need for protective stands for soil and water conservation, crop protection and in general better land use. The recommendation was made that over the next 20 years 6 million hectares should be afforested and 10 million hectares improved.

Furthermore, the increased requirements of European industry as well as certain changes in the type of products demanded and the modifications taking place in the economic and social conditions of forest management and exploitation, often call for an intensification of silviculture and complete reconversion of large areas of existing stands. This more often than not requires heavier investment than private individuals can afford. This is true particularly with regard to the conversion of coppice into high forest, the improvement of hardwood stands by the introduction of softwood species, and finally the equipment of hitherto inaccessible stands.

On the other hand, forest extension and rehabilitation work can only be satisfactorily carried out as part of a long-term plan calling for continuous effort spread over many years and hence requiring a continuous flow of funds. Preparatory studies are necessary to determine which soils have to be afforested and research is necessary to determine the best planting techniques; such work also requires that seed and selected plants be supplied, something that becomes feasible only after long preparation. Finally, it calls for the training of skilled workers who must be given assurance of steady employment and have efficient equipment at their disposal. Plantations may fail and the outlays they have entailed may go to waste if costly maintenance operations are discontinued for want of sufficient and timely funds.

Under these conditions various formulae have been studied and national forestry funds have been set up in several countries. The following are some examples.

Patrimonio forestal del Estado

In Spain the Patrimonio forestal del Estado, set up by law in 1939 and reorganized by a further law in 1941, is an incorporated body enjoying financial autonomy and attached to the Ministry of Agriculture. The original purpose was to provide for the rehabilitation, conservation and extension of the public domain forests so that they might really accomplish their economic and social functions for the country. Later this body expanded its activities and became a state agency empowered to undertake forestry projects on behalf of communes or private owners on a contract basis.

The usefulness of this body, that has afforested or reforested 1,300,000 hectares in 20 years, lies principally in the fact that it is financially autonomous, and therefore more flexible than government agencies, and that it has decentralized administrative services with full powers in each region.

The Fund derives its income from two main sources:

(*a*) an annual budget subsidy from the State set by the law of 1941 at 10 million pesetas (approximately U.S.$300,000) and later raised to 500 million pesetas (U.S.$8,000,000);

(*b*) income from the exploitation of state forests as well as of reforested areas.

The Forestry Commission

In the United Kingdom the implementation of the forest laws promulgated between 1919 and 1951 is the province of the Forestry Commission, which is accountable annually to Parliament for all expenditure. Its expenses, including grants and loans to private forestry, are covered by:

(*a*) receipts from forest products and rents from lands and assets other than those strictly belonging to its forest estate;

(*b*) a balancing figure voted annually by Parliament.

A forestry program was formulated in 1943 proposing that the extent of properly managed forests, both privately and publicly owned, should be raised from 2 million to 5 million acres (from 800,000 hectares to 2,000,000 hectares) by the end of the century. This long-term program was not adopted in its entirety by the Government, but short-term programs within the long-term concept have been formulated from time to time. The forest policy for the United Kingdom has been broadly accepted by the different political parties so that, notwithstanding changes in the political majority in Parliament, the Forestry Commission has felt reasonably certain that the finances necessary for the approved program would be forthcoming.

Fonds forestier national

In France the Fonds forestier national was set up by a law of 30 September 1946. It consists of a special Treasury account into which is paid a tax levied on products from sawmills and forest exploitation, but not on fuelwood. The law envisages the adjustment of tax rates within specified limits in such a manner that the authorities responsible for implementation of the plan may adapt the Fund's receipts to practical needs and take constantly into account the current

financial situation of those liable for forest taxes, as determined by the fluctuations of the timber market. There may be partial or total exemption from taxes for certain commodities, when their markets have to be protected or enlarged. The financing of the Fund is therefore somewhat flexible, in order not to hamper the forest economy and permit constant adaptation of work programs to requirements.

The Fund grants subsidies, for which it does not expect repayment, as well as low-interest capital loans (simple interest of 0.25 %) and long-term loans often adjusted to the low returns from many stands.

Financial autonomy enables this Fund to decide its own order of priorities for projects independently of other branches of investment. Within the forestry sector, priority is determined for each project according to its economic value (higher returns and improvement of the commercial balance or balance of payments) or social value (establishing better equilibrium in depressed rural areas).

Two thirds of the allocations are used for afforestation, stand improvement, reforestation, new plantations outside the forest and other operations. One third goes to stand conservation, protection and equipment; 80 percent of the credits set aside for afforestation or reforestation answer to the first requirement (economic value) and 20 percent to the second (social value). These priorities apply throughout the country.

Advantages and drawbacks

The significant achievements attained by existing national forestry funds have attracted the attention of other governments and forestry circles. Continuity and flexibility in financing, permitting long-term planning and rapid execution of projects, are the arguments invoked in their favor. They have also made possible the development in public and private sectors of projects in the public interest, whether for soil and water conservation, making forests accessible for recreational use, ensuring a steady timber supply to a country or for helping the government or private owners to make the necessary investments to intensify silviculture.

It is therefore as well to underline the fact that the setting up of national funds to promote forestry not only procures certain advantages for private owners and forest labor in general, whereby they may be recompensed for the special hardships under which they work in a relatively less favored sector of the economy, but is also the recognition of the fact that, directly or indirectly, forestry and its corollary, the need for over-all planning by the State, are in the public interest.

Once the goals have been set, even provisionally, the national forestry funds can lead to the attainment of the desired objectives, either through specific public works programs or public action designed to influence private decisions, or by a combination of both types of action, in proportions still to be determined.

The setting up of such funds has aroused lively discussion as well as some criticism. One much debated subject is the source of their financing. If they are financed out of the regular state budget, it is the entire country that maintains them, which is perfectly justified in the case of projects in the national interest but might raise objections in cases where only a private sector of the economy is being helped. If, on the other hand, taxes are levied on the forest economy sector, the expenses are borne by the initial beneficiaries of forest improvement, which is quite justified when it is a matter of helping private stand owners to increase their stand yields and improve their forests, but might raise doubts as to the benefits to the community as a whole.

We might therefore consider whether forestry funds should be financed out of a combination of public funds and levies on the sector of the economy concerned, and whether the ratio of work of general interest to work of private interest should be determined accordingly. Whatever the decision, it does not seem that state investment in the financing of forestry undertakings, particularly in the setting out of plantations of quick-growing species, need be sacrificed for projects in the public interest that promise only very low, delayed returns. The State should retain the option of reserving a forest domain for iself in which receipts and expenditure are as balanced as possible.

The setting up of forestry funds by means of an automatic levy on one sector of the economy, i.e., forest industries, has also given rise to objections of another type. Some people feel that such funds may freeze credit that could very well find an outlet in other sectors or that they may use financial resources derived from forests for other than strictly forestry purposes as a result of too broad an interpretation of the regulations. The fact that a tax is levied only on certain commodities, for instance timber, might be considered a protectionist measure for other products, such as fuelwood.

These drawbacks may certainly be avoided by allowing for the possibility of changing tax rates within specified limits and exercising rigorous control over expenditure. On the other hand, it seems inevitable for forestry funds to be exposed to possible use by the Treasury to cover expenses in other sectors.

Another criticism of taxing forest products is that this may lead to lower receipts when the timber market and economic conditions in general are depressed. This is precisely the time when, for social and economic reasons, it may be desirable to press on vigorously with forest extension and improvement work. Afforestation, road building and other forest development can best be carried out at such times in the form of public works.

Finally, a criticism of forestry funds financed from sources other than public funds is that this constitutes double taxation, which is forbidden by the constitutions of most countries, or else that it relieves one sector from taxation, which is contrary to the principles of equitable taxation.

(*For comment, see foot of page 184*)

Current Trends in Scientific Research in Forestry and Forest Products

Pierre Auger

A survey, Current Trends in Scientific Research, *which analyzes the main trends of inquiry in the field of the natural sciences, the dissemination of scientific knowledge and the application of such knowledge for peaceful ends, has recently been published jointly by the United Nations, New York, and the United Nations Educational, Scientific and Cultural Organization (UNESCO), Paris. The volume, which is not only the first of its kind but is also likely to be one of the most important basic scientific works of the coming decade, has this to say on trends in research related to forestry and forest products.*

Natural science applied to forestry

Basic to effective management of soil, water, forest and grass resources are current studies of the factors of environment. These include research in soil relations to determine those characteristics of forest, brush and rangeland soils that affect their hydrology and stability, with special regard to infiltration of water, storage of moisture and percolation and erosional processes. The elements of local climate as affected by vegetation types and conditions and changes in such vegetation are studied by measurement of soil and air temperatures, precipitation, wind movement, snow storage, humidity, evaporation, and radiant energy under various topographic and geographic locations and under natural and modified vegetation conditions. Evaporation-transpiration losses are being investigated with special effectiveness. The establishment, development and yield of herbs, grasses, shrubs and trees are examined in the light of these weather factors. These results in turn are integrated into studies of rehabilitation, protection and improvement of soil and vegetation to achieve conservation through careful use of land and water, and to prevent excessive erosion and stream sedimentation.

Recently through the use of radioisotopes much of value is being learnt of the physiology of trees and shrubs with regard to nutrient requirements and water conduction. Flowering, fruit and seed production, and effects of growth-promoting substances in vegetative propagation are being studied with good effect. Studies in photosynthetic efficiency and photoperiodic response of forest trees are making clearer the question of light requirements for growth, particularly in relation to competition among trees in forest stands.

Progress is marked in genetics research in variation and selection, manner and strength of inheritance of economically important factors such as fibre length and thickness, and in production of interspecific and intraspecific crosses for superior characteristics of form, growth rate, and resistance to pests.

The phylogenetic relationship between species is being studied, in the case of the genus *Pinus,* for example, on the basis of their oleoresins. The task of identification, classification, and distribution of herbaceous and shrubby forage and range vegetation and of forest trees continues in its unspectacular, but highly important, methodical course.

The silvics, or study of establishment, growth and development of trees and forests, is receiving concentrated attention locally as the foundation for silvicultural practices. Special effort is devoted to the effect of such silvicultural practices as thinning, and use of controlled or prescribed burning on the productivity of forest soils.

Protection of forests and ranges against fire, diseases and insect pests is the subject of research into such elements as:

(*a*) fire behavior, fire-danger rating, psychological factors in people's motives and habits for preventing fires, use of aircraft, chemicals for firefighting, beneficial use of fire, lightning prevention and cloud seeding; the pathology of foliage diseases, rusts, cankers, dieback and wilts, malformations, decays, and root ailments, genetic resistance, disease survey techniques, seed and seedling pathogens, rot of wood in transit, storage, processing and use;

(*b*) the incidence and behavior of bark beetles, sawflies, spruce bud-worm, weevils and moths, and the interrelationship of insects and diseases as in the case of elm phloem necrosis, Dutch elm disease, and oak wilt. Special attention is being given to the prediction of epidemics and to the chemical and biological control measures against diseases and insect pests.

Forestry science proper

The management of forests and ranges for the volume and quality of product desired at the time required is the integrated result of research in silvicultural and vegetational control methods. Studies are accordingly

being made of harvesting techniques which will assure regeneration of desired species and maintenance or increasing of soil productivity. This involves research into species composition, stocking density and age-class distribution for each major forest type and condition. Such cultural techniques as pruning, thinning, and use of arboricides and mechanical means for stand improvement through elimination of undesirable species and individuals of inferior form, are the subject of local research of an applied nature.

The control of grazing on forest and open ranges to attain sustained yields of nutritious forage and efficient livestock production at maximum levels consistent with soil and water conservation requires careful investigations of such elements as season, intensity and system of grazing, forage value of range species in terms of herbage yield, digestible nutrients, or undesirable properties, standards for judging current condition and productivity of specific range types, and of effectiveness and costs of supplemental food or minerals, and water developments. In this field also, investigations are carried on with regard to forage and other improvements in the habitat of game animals for hunting.

Considerable attention is being given to the artificial establishment of forests through planting which involves concentrated research in seed collection and handling, nursery practices, site preparation and direct seeding and planting methods, as well as more basic studies of species adaptability, both native and exotic; production of seed of superior genetic strains and individuals in tree seed orchards; and spacing requirements in relation to pruning and early thinning for specific products.

A special form of tree planting to protect agriculture involves careful studies of shelterbelts and windbreaks, particularly in areas and under conditions not favorable to tree growth. Tests are made of native and exotic species, methods of planting and care, and of shape, size and direction of belts in relation to modifying wind movement to reduce excessive evaporation from crops and soil.

Systematic mathematical research is being carried out on such problems as volume estimation, growth, mortality, defect, and yield prediction, sampling to determine log and standing tree contents, and inventory methods for appraisal and management purposes.

Considerable research of an applied character is done in adapting engineering techniques and design of machinery and equipment to the needs of forest harvesting and cultural measures in the forest. Although it is largely mechanical, the natural science aspects of forestry guide the studies which are conducted to render forest operations more efficient from the labor-input angle and less destructive to the residual forest from a biological standpoint.

Primary forest products

Research continues into the structure and identification of woody species, their physical and mechanical properties, the factors affecting the strength of wood, machinery and wood-working qualities, finishing, gluing, veneering, seasoning, fire-resistance treatments, preservation, chemical properties, and suitability for pulp and paper, and hydrolysis. Of late, increasing attention is being devoted to studies of the electrical properties of wood, vibrational characteristics, and effect of temperature on strength which are important in improving kiln drying and preservation.

An important field of investigation is the variation in structure, chemical composition and properties related to growth conditions, particularly as regards soil properties, spacing and age of trees, elevation, exposure, and climate of the growing site, as well as the effects of thinning, pruning, intermediate cutting, and heredity.

Great advances have been made in developing a variety of new wood products in the form of fibreboard, particle board, and combinations of such reconstituted materials with plywood and paper. This involves careful research into the effect of particle size, kind and shape, adhesives, and processes. Investigations are aimed at improving processing and developing new pulp and paper products, and discovering the chemical microstructure of wood. Research into the colloid chemistry (fundamental surface chemistry) of wood has opened up new possibilities through such studies as the absorption of water vapor at different temperatures for calculating bonding energies, the bonding of concentrated alkalies by cellulose using radioactive tracer techniques, diffusion of material through wood, limiting sizes of molecules that can penetrate and swell cell walls, the change in molecular weight of cellulose accompanying hydrolysis, and the distribution by size of pit-membrane pores which control flow through wood.

Similarly, efforts are continuing in modifying properties of wood for special uses, including stabilizing dimensions of wood based upon treatment with wood-derived furfural and its conversion to a resin within the structure; altering resin-treated woods for molding purposes. The chemistry of wood preservatives is receiving an increasing amount of attention, particularly as to their toxicity toward wood-destroying agencies to prolong the life of wood in use.

The merging of the results of these investigations with the information obtained by the silvicultural research worker will inevitably lead to a greater variety of marketable wood products and the more profitable and effective management of forest vegetation, particularly in the underdeveloped forested regions of the world.

The Arusha Conservation Conference

G. G. Watterson
Secretary-General, International Union for Conservation of Nature and Natural Resources (IUCN)

"The survival of our wildlife is a matter of grave concern to all of us in Africa. These wild creatures amid the wild places they inhabit are not only important as a source of wonder and inspiration but are an integral part of our natural resources and of our future livelihood and well-being.

"In accepting the trusteeship of our wildlife we solemnly declare that we will do everything in our power to make sure that our children's grandchildren will be able to enjoy this rich and precious inheritance.

"The conservation of wildlife and wild places calls for specialist knowledge, trained manpower and money and we look to other nations to co-operate in this important task — the success or failure of which not only affects the continent of Africa but the rest of the world as well."

J. K. Nyerere - Prime Minister
A. S. Fundikira - Minister for Legal Affairs
T. S. Tewa - Minister for Lands and Surveys

This Arusha Manifesto expresses in clear terms the attitude of the host Government of Tanganyika toward the conservation and development of its wildlife resources. It epitomizes also the tone of the discussions throughout the Pan-African symposium on the Conservation of Nature and Natural Resources in Modern African States, which constituted the second stage of IUCN's African Special Project.

The meeting, held in early September 1961 at Arusha, Tanganyika, was attended by 139 participants from 21 African and 6 non-African countries, and 5 international organizations, not counting the Commission for Technical Co-operation in Africa South of the Sahara (CCTA) and IUCN who were jointly responsible for the preparation of the Conference. Among the participants were 15 "fellows" from the Central African Republic, Chad, Dahomey, Kenya, the Federation of Rhodesia and Nyasaland, Tanganyika, Togo and Uganda. Funds for this purpose had been offered by the American Conservation Association, the Deutsche Afrika-Gesellschaft, the Fauna Preservation Society, the Governments of Sweden and Switzerland, and by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

Among the messages of interest and good wishes for success that were sent to Arusha were those from Prince Bernhard of the Netherlands and Prince Philip, Duke of Edinburgh.

In his opening address, Sir Richard Turnbull, Governor of Tanganyika, who combines first-hand knowledge of the general deterioration of natural resources with considerable experience of the human and social problems of a modern African state, spoke in terms of the disasters which will inevitably descend on the people of a country if its natural renewable resources are not conserved. He stressed the fact that the preservation of wild animals, an undoubtedly great national asset, was dependent upon one overriding consideration, the preservation of the habitat. He acknowledged that man and his domestic animals were multiplying unchecked to bring about their own ultimate destruction by ruining for ever the land they lived on. And after outlining the wildlife policy of the Government of Tanganyika and the various problems which this raised, he summarized the situation under three main considerations: wildlife and wild nature were an undoubted source of revenue needed for social services, and must therefore be rationally "exploited" where this was the best form of land use; public opinion, whose support was essential, must be convinced of the value of this heritage; and international aid would be needed if the world in general wished to see Africa's unique fauna preserved in Africa for the benefit of the people of Africa.

The joint organization of the meeting, under the co-sponsorship of FAO and UNESCO, boded well for such international support. J. S. Annan, of FAO, drew attention during the inaugural session to the destruction of wildlife, coupled with inadequately planned land-use practices, which constituted a real threat to the natural resources of Africa. He pledged FAO's full co-operation and support in assisting governments to develop a rational approach to integrating the conservation and development of wildlife resources into their programs of economic expansion. A. Gille, of UNESCO, spoke in similar terms, giving special emphasis to the need for general education in the principles of conservation as a basis for intensified rational use of Africa's natural renewable resources if the continent was to take its proper place in international affairs.

The Economic Commission for Africa of the United Nations (ECA) was also represented, and it was pointed out that the organization was already planning to conduct some research into the economics of tourism, based essentially on wildlife, in East Africa.

It was clear also that many nongovernmental organizations such as the International Union of Official Travel Organizations (IUOTO), the Conseil international de la chasse (CIC), the International Council for Bird Preser-

vation (ICBP) and the Fauna Preservation Society, were anxious to assist. And there were indications also of bilateral and private aid such as that given by the Frankfurt Zoological Society which was putting up $5,600 for a hostel for visiting children in the Serengeti park.

In the light of such numerous and diverse offers of technical and financial help, the conference stressed the overriding need for ensuring that such necessary assistance be channeled in such a way as to avoid wasteful duplication, and thus encourage outside aid. It therefore warmly commended the implications of Stage III of IUCN's African Special Project as an essential follow-up to the conference and the change of attitude which it has so clearly brought out.

The establishment of a team of two consultants, comprising this Stage III, was considered as the only known effective means whereby situations and needs in Africa could be analyzed and assessed, priority determined, and help from outside adequately and impartially channeled.

The members of the team are Thane Riney,[1] senior Fulbright fellow who has long been working in east and central Africa on wildlife management problems, and Peter Hill, previously manager of the experimental station attached to the Department of Agriculture of the University of Ghana. This team will be ready to begin work in Africa at the beginning of 1962, and its activities will be planned in the light of requests for guidance which are already coming in to IUCN's headquarters at Morges.

Other recommendations and wishes formulated by the conference were on the subject of international aid for education and training in conservation at all levels; on land-use policies which should, among other objectives, aim at avoiding the occupation by agricultural and pastoral communities of land unsuited for such use in the long term, and on the need for greater attention to the economic aspects of the development of natural resources. Finally, the wish was expressed that countries assist in creating throughout Africa a type collection of natural habitats, and that a qualified scientific authority be consulted on its establishment and on the research to be undertaken within each area.

As Professor Baer, President of IUCN, said during the inaugural session, "Man in the past, out of sheer ignorance or greed, has wastefully destroyed plant and animal life, forgetting that neither he nor his children's children can ever become completely independent of their environment, and overlooking the possible contribution that these now extinct forms might have made to his own welfare."

The conference was a milestone in the history of the development of an awareness of the need for conservation of nature in Africa. In the words of Professor Théodore Monod, President of the Scientific Council for Africa South of the Sahara (CSA) and a member of the Executive Board of IUCN, Tanganyika has every reason to be proud of the part she played in this big common effort, in hastening the day when Africa will be the shining example to the world of a continent which, fully aware of the incomparable, irreplaceable value of its natural wealth, has devised ways of wise husbandry, avoiding unneeded destruction and achieving a sense of interrelationship between man and his environment in the interests of its own peoples and of mankind in general.

[1] *See also Unasylva*, Volume 15, Number 2. "The international importance of African wildlife."

COMMENT ON "NATIONAL FORESTRY FUNDS"

(*See pages 178-180*)

The European Forestry Commission debated this subject and, after information had been given by delegates both on the forms of financing adopted in general in their countries, including forestry funds, and the respective merits of the different methods used, it became apparent that, either by the establishment of forestry funds or by other procedures and means, European countries had on the whole the necessary procedural machinery for ensuring both the improvement and development of the existing forests and their extension for physical, economic or social reasons.

Emphasis was laid on the need to include in the budget of funds the expenses relating to research, which is essential for the implementation of plans and programs of forest extension and rehabilitation. Provision should also be made for conducting active publicity campaigns in favor of wood and for educating public opinion in regard to forestry. It was suggested that the financial resources mobilized by national funds should be so used as to enable them to have a cumulative effect. This could be achieved either by combining money from other sources, or by encouraging further related investments.

Forest Seed Handling Equipment and Procedures

I. SEED PRODUCTION, COLLECTION AND PRODUCTION

R. Morandini
Professor, Stazione Sperimentale di Selvicoltura, Florence, Italy

This paper, which is being published serially, is based on experience gained in several countries and describes the procedures, equipment and machinery used for several kinds of forest seed. It should be read in conjunction with Handling forest tree seed, *FAO Forestry Development Paper No. 4, published in 1955. Comments, amendments and additions will be welcomed in order to make this document more complete and provide an efficient guide to seed handling techniques. A list of contributors and a bibliography are available on request from the forestry and Forest Products Division, FAO Rome.*

Seed Production

In recent years programs of afforestation and reforestation have been planned and carried out at an increasing rate in many areas of all continents. This has resulted in a remarkable increase in the demand for forest tree seeds, which are often quite difficult to find, prepare and handle.

Seed Stands, Trees, Orchards

When artificial regeneration was first applied in forestry, the only problem was that of getting seed or nursery stock of desirable forest species, regardless of its genetic worth. But substantial failures of many large plantations, as well as several trials and investigations, proved the basic importance of the seed origin, which is today recognized everywhere by forest geneticists and research workers. Some forest administrations have prepared special laws in order to insure effective control of the forest seed provenance; but even nowadays many countries do not attach sufficient importance to this question.

The first step to insure provenance control is to identify, for each important tree species, a number of production areas or stands which, according to certain criteria, may be considered as suitable seed sources. Seed stands should consist mostly of very good trees, preferably middle-aged (generally 35 to 40 years is a minimum for conifers). Good stem form, small branches, rapid growth rate, and soundness are the main characteristics required. Moreover, it should be kept in mind that seed production is influenced by stand density, and that the stand should cover an area large enough to make collection convenient from an economic point of view.

Seed could also be collected from individual trees which combine to the highest degree the desired characteristics (" plus trees " or " elite trees "). But the collection from individual trees is usually carried out only for scientific purposes.

Lately, the development of forest genetics and tree breeding has led to the concept and establishment of seed orchards. Seed orchards are plantations of genetically superior trees, isolated to reduce or prevent pollination from outside sources. They are established by setting out clones (as grafts or cuttings) or seedling progeny of trees selected for desired characteristics. When seed orchards are established while genetic evaluation of the parent material is still under way, components shown by progeny tests to be undesirable should be removed from the orchards.

Seed orchards are expensive to establish, but they can yield a large quantity of superior seed some years after their establishment. Seed collection is less expensive and the use of special harvesting equipment is possible.

Harvest Forecast

Seed-bearing of forest trees is usually rather irregular from year to year. Only a very few species bear good seed crops every year. Generally one year of a heavy crop (seed year) is followed by one or several years of poor seed crop or none at all. Many conifers show intervals between seed years of three to four years. Most spruces, for instance, bear good crops at intervals of five years and occasionally at longer intervals up to seven years, light crops being rather common in the intervening years.

In order to organize seed collection properly it is therefore very important to forecast fruit-setting some months before collecting time. The estimates of seed crops are generally based on counting or weighing cones or fruits on a number of sample trees. The results are applied to the stand and are finally expressed as numerical values, going from 1 (total crop failure) to 10 (maximum crop, exceptional seed year).

The ripeness of seeds and the beginning of natural seed dispersal are the main factors which limit the time suitable for collection.

Methods of Judging Seed Maturity

Seed ripeness is often judged by the color of fruits or cones, but a better indication is provided by their specific gravity. The specific gravity of cones or fruits decreases as the seed approaches maturity. A mixture of various liquids may be adjusted so that ripe cones of a given species will just float. Cones may also be tested in a set of liquids, with different known specific gravities.

The surest check of seed ripeness is to cut cones or fruits in two lengthwise, and examine the seeds which occur on the cut surfaces. By this method the number of fully developed seeds per fruit or cone can be counted at the same time. A good knife is often sufficient for this purpose, but special knives have been prepared which prove very useful for most cones and for some tougher fruits of hardwoods.

Collection of Seed or Fruits

Methods and Equipment

TIME FOR COLLECTION

Seeds or fruits should usually be collected just as they have reached full ripeness, and before natural dispersal begins. This interval varies considerably in the different tree species, and with local climatic conditions. For many conifers, especially spruces, long autumn rains or fogs delay cone opening for a long time, while a few dry windy days are sufficient to give full seed dispersal. A general idea for seed collecting time in northern Europe is given in Table 1 compiled recently by the United Kingdom Forestry Commission.

Table 1. – Frequency of Cone Crops and Months of Cone Collection

Species	Average frequency of good cone crops (years)	Months of cone collection		
		Earliest	Normal	Latest
Scots pine (*Pinus sylvestris*)	2-3	Nov.	Jan.	Feb.
Corsican pine (*Pinus nigra* var. *calabrica*)	3-5	Dec.	Jan.	Feb.
Lodgepole pine (*Pinus contorta*)	2-3	Dec.	Jan.	Feb.
European larch (*Larix decidua*)	3-5	Oct.	Nov.	Dec.
Japanese larch (*Larix leptolepis*)	3-5	Sept.	Sept.	Oct.
Hybrid larch (*Larix eurolepis*)	3-5	Sept.	Sept.	Oct.
Norway spruce (*Picea abies*)	3-5	Oct.	Oct.	Nov.
Sitka spruce (*Picea sitchensis*)	3-5	Sept.	Sept.	Oct.
Serbian spruce (*Picea omorica*)	2-4	Oct.	Oct.	Nov.
Douglas fir (*Pseudotsuga menziesii*)	4-6	Sept.	Sept.	Oct.
Noble fir (*Abies nobilis*)	4-5	Aug.	Aug./ Sept.	Sept.
Grand fir (*Abies grandis*)	3-5	Aug.	Aug./ Sept.	Sept.
Western red cedar (*Thuja plicata*)	2-3	Aug.	Sept.	Sept.
Western hemlock (*Tsuga heterophylla*)	3	Aug.	Sept.	Sept.
Lawson cypress (*Chamaecyparis lawsoniana*)	3	Aug.	Sept.	Sept.

COLLECTION ON THE GROUND

Seeds and fruits can be picked up from the ground after shedding. This is the case of many large-sized seeds of broadleaved trees, such as oak, chestnut, and beech. If possible, the ground should be cleaned from brush, and a sheet placed under the tree makes collecting much easier. Seeds should be picked up as soon as possible after they have fallen to avoid losses and damage by insects, rodents or fungi; but it should be kept in mind that the first seeds or fruits which fall naturally are often of poor quality.

For all trees, a very easy and cheap method of collection is to take account of normal fellings occurring during the seed ripening season, and to collect seeds or fruits from felled trees. This method is largely used in northern Europe.

In North America seeds are sometimes collected in the hoards of small rodents, which often gather large quantities of different seeds, especially nuts, for their winter reserve.

COLLECTION FROM STANDING TREES

The greatest quantity of tree seeds is collected from standing trees. This method is clearly often difficult and expensive, but it ensures that seeds come from selected trees and from the best part of their crown. In the case of shrubby or very small trees, seeds can be picked directly from the branches by the collector while standing on the ground. For small or medium-sized trees, poles, pole saws or trimmers are used for collection, the operator standing on the ground or on the lower branches of the tree.

Hooks of different shapes, cutting edges or little saws are attached to a long pole. By moving the pole, fruits or cones can either be detached from the branches, or the twig (in the case of small fruits) can be cut down completely. Sometimes a sack or a basket with a wire end can be used for fruits which are easy to detach.

The length of the pole (that is the height which can

be reached) depends on the weight and rigidity of the pole itself. Different materials are used:

(*a*) bamboo is very light but not sufficiently rigid;
(*b*) steel pipes are too heavy;
(*c*) aluminium or plastic poles often give good results.

For large-sized trees, the normal method of collecting seeds is to climb the tree. Some forest workers are very good tree climbers, and climb tall trees without any equipment. But this method, besides being dangerous, tends to make the operator choose trees for their climbability and not from the point of view of seed quality. If possible, good seed trees should be marked by a skilled technician, and workers should not be allowed to climb trees other than the marked ones.

Low branched trees are easily climbed, and a normal climber is able to climb a trunk, even without branches, for a few meters, if the tree diameter is not too big (not over 40 centimeters). Otherwise, some equipment, such as irons or ladders, is required to reach the lowest branches.

Climbing equipment

Foot-clamps, foot-hooks or climbers. These are some of the usual types of climbing equipment: a forged iron is fastened by a belt to the climber's shoe (Figure 1) (sometimes to the leg too), and finishes in a pointed spur, the length varying according to the climbing method. One of the best types is a German one, where the hook is quite short and does not extend beyond the shoe sole, permitting the climber to walk on the soil without difficulty. The irons always cause some damage, especially to very thin-barked trees: round points seem to be preferable from this point of view. Irons should not be used when the bark is frozen.

FIGURE 1. – *Tree climbing irons.*
Courtesy, Morandini.

Ladders. Many types of ladder are used in tree climbing. Type, form, length and material vary largely according to tree species and local conditions. In level country and where forests have an extensive road network special ladders, which are sometimes heavy, can be transported by truck. In mountain forests transport difficulties arise and only small, light ladders may be employed.

For smaller trees, a light wooden ladder is perfectly adequate; types used by fire services, 6 to 8 meters long, do not weigh more than 2 kilograms, and can also be transported in mountain regions: they have to be used in a vertical position, i.e., parallel to the trunk.

Naval rope ladders are sometimes used: a finer cord is thrown to a strong branch, and the rope ladder or cord is then fixed to the branch.

Greater heights require scaling ladders which can be assembled and dismantled. They may be of different types and materials: wood, aluminium, steel, and magnesium alloy are used. The elements of the ladder have a variable length (2 to 4 meters) according to their weight, which should not exceed 3 to 4 kilograms per element, to ensure easy transport during climbing. A small, adjustable platform is placed under the base of each leg, to ensure stability on the ground. Each element is fitted easily and safely into the lower one and, when in place, it is fastened to the trunk by a chain or a belt which the operator fixes while ascending.

Assembled scaling ladders may have one or two legs: two-legged ladders are more common and more easily purchased or constructed.

The type shown in Figure 2 is a duraluminium ladder, built in 2- to 2.5- to 3-meter sections; supports an drungs are of tubing, 3.5 centimeters and 2.5 centimeters in diameter respectively. The ladder weighs 1.3 kilograms per meter, including the fastening chain. Elements may be connected without limit: this type has been used up to a height of 38 meters. However, the rungs could be more widely spaced, and the connection improved. (This ladder was designed by the Ecole nationale des eaux et forêts, Nancy, France.)

One-legged ladders are useful on steep or rocky ground where it is difficult to lodge a two-legged ladder evenly, and also in the case of a tree with many branches where it is hard to place a two-legged ladder along the trunk.

Small bars are fixed as rungs alternately on either side of the central support. The form of the rungs varies with the type of ladder. One-legged ladders can be attached by chains very close to the trunk against which they are held by a special spacer. These ladders can be attached to trunks which are not quite straight and continued up into the crown. They are easier to place on the ground than two-legged ladders, although transport during climbing is not so easy; but no special difficulties arise. The weight and length of the elements do not differ much from those of two-legged ladders, because the central support is generally in steel tubing. One-legged ladders give very good service, and are widely used especially in Germany (Figure 3).

FIGURE 2. – *Scaling ladder.*

FIGURE 3. – *Type of one-legged ladder.*

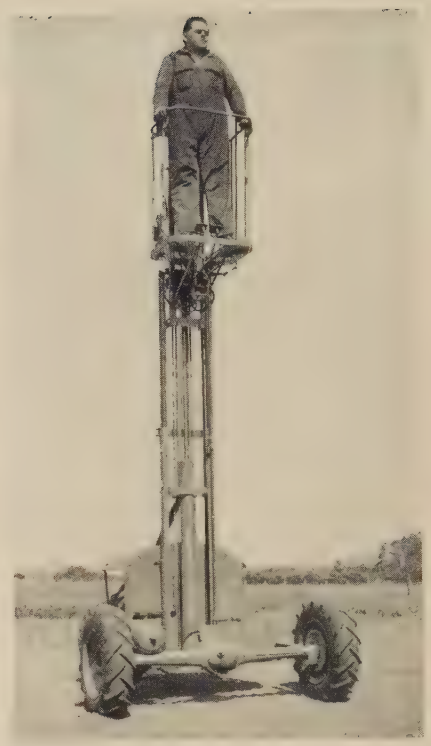


FIGURE 4. – *Transportable extension platform.*

FIGURE 5. – *The " Baumvelo " apparatus.*

Extension telescopic ladders may be placed and transported by special trucks. Fire-service extensible ladders are used to enable the worker to reach heights of from 20 to 25 meters. They may only be used in forests in the plains or for collecting seeds on trees growing at roadsides.

An extension ladder in light alloy, which may reach a length of 14 meters, is mounted on a tractor, and can therefore be used also in forests without roads. A special model has been developed by the United States Forest Service. The truck is 0.5 ton pick-up, on which a rectangular framework is mounted, supporting a heavy-duty aluminium extension ladder, 12 to 15 meters long.

Telescopic platforms rolling on wheels sliding under carriage or mounted on special trucks are also used (Figure 4).

A special apparatus for tree climbing is the Swiss " Baumvelo " (Figure 5). It is a device for climbing straight branch-free trees, without damaging them, and is preferable to a ladder because it is much easier to transport and to use in dense forest stands. It consists of two similar parts, one for each leg. A vertical arm supports a pedal in which the operator's shoe is fastened; at its upper end it is connected to a steel belt, forming a circle of adjustable diameter around the stem; a supporting block is fixed in the middle of the arm. After reaching the crown, the climber can easily leave the " Baumvelo, " attached to a branch, and climb freely into the crown, special safety belts being provided. This device has been developed by the Eidg. Forstliche Versuchsanstalt, Zurich, and has been favorably received in various countries, especially in the United Kingdom,

FIGURE 6. – *Tree climbing net.*
Courtesy, United Kingdom Forestry Commission.

where the Forestry Commission has improved the related safety equipment.

Another tree climbing device is the tree net, developed in the United Kingdom by the Forestry Commission (Figure 6). A triangular net is suspended by special ropes and snatchblocks from the top of the tree, and covers a large part of the crown; the collector can thus easily reach all parts of the crown. This equipment seems to give good results for large branched trees bearing small fruits which take a long time to collect. Special equipment is available for rigging the net, but the operation is time-consuming and is very difficult, or quite impossible, in dense stands.

Sometimes permanent or semipermanent scaffolding, in iron pipes or wooden poles, is built around the trees; this is done mainly for scientific purposes, to collect seeds or scions or to control the pollination of plus trees.

Transport to the Seed Extractory or Storage Point

Collected cones or fruits are put into sacks generally with a capacity of 1 hectoliter (3 bushels), corresponding to about 50 kilograms (100 pounds) in weight. Sacks or other containers should be filled and closed under proper supervision, and their number or weight checked, to ensure provenance control.

If cones or fruits cannot be transported at once to the storage point or factory, provisional storage should be arranged locally, in huts or under some kind of shelter; in any case sacks or containers should not be stored in large amounts over a long period. Various kinds of transport can be employed. Trucks are generally used, but railway transportation is more economical over very long distances. While loading trucks or cars, care should be taken to ensure proper air circulation among sacks. Over short distances, cones could be loaded onto the truck without containers: in this case, each truck should carry cones or fruits of one single provenance and species.

Extraction

The word "extraction," in the wider sense, includes all the different operations or processes necessary after collection to prepare seed for sowing. This preparation usually consists in separating the seed from all or some parts of the fruit. It is easy to understand that extraction technique varies greatly according to the species: some seeds are quite ready for sowing as collected from the tree; others are obtained after a long series of difficult processes, i.e., opening of cones, separating seed from wings, etc.

Extraction usually consists mainly of one or more of the following processes: washing, maceration, threshing, drying, separation, de-winging, cleaning.

Some of these operations could be carried out in a very simple manner, and do not require any special equipment; but often, and in any case when large amounts of seeds are to be prepared, a special extractory must be established, with stores, machines and any other equipment required for the various operations.

Hitherto seed separation has been carried out by very simple means in most countries, so that machines specially made for forest seed handling are difficult to obtain, and often agricultural machines have had to be adapted for this purpose. During recent years, however, some special machinery has been developed and constructed.

General Scheme of Handling

All operations, whether for extraction of small or large amounts of seed, must follow a certain sequence. It is clear that certain processes could sometimes be delayed, or left out altogether in the case of occasional operations, while in the case of a permanent seed plant with large output a careful organization of the working cycle is absolutely necessary. In any case extraction should follow a general line, which is briefly described below.

Cones or fruits coming from collecting points go to pre-cleaning, and pass at once, or after storage, to extraction. Fleshy fruits are submitted to maceration, cones are dried (naturally or artificially) and tumbled, other types of fruits are threshed. After extraction, seeds are de-winged (if necessary), cleaned and put in storage.

A seed plant should therefore include the following rooms and equipment:

1. reception room, and precleaning room and equipment (preferably on the ground floor)
2. stores for fruits or cones
3. a local store (placed above the kilns or extractors) supplying machines
4. kilns or yards to dry cones or fruits, respectively artificially or naturally
5. extraction room and machines (including dewingers and cleaners)
6. seed stores.

Rooms and equipment should be placed so that fruits and seeds pass from one operation to the next in the easiest and safest way, providing as far as possible mechanical transport between machines. A two-storey building is often recommended. The working material comes to the upper floor from the precleaning plant or from the cone or fruit stores. It is placed here, in a local store, directly supplying kilns which are placed on the first floor. From the kilns seed falls down to the ground floor where separation and cleaning equipment is located. Stores for fruits or cones and for seed are generally placed in one or more separate buildings.

The size of any equipment, installation or plant should be carefully studied and planned in relation to the amount of seed required per year. It should be borne in mind that many species do not give a good seed crop every year, so that in good seed years it is necessary to collect and process a supply of seed for two or three years. Therefore, the equipment must be proportionate to the amount of fruits or cones collected in such years.

Even if good storage facilities for fruit or cones are available, it is preferable to keep the working season as short as possible, to avoid storage difficulties, deterioration, and loss of seed quality. The interval between fruit collection and seed preparation is strictly related to the local climatic conditions.

The choice of machinery should be made after considering the output per hour required, which may be calculated by the formula:

$$W = \frac{S \times F}{Y \times P \times T}$$

where:

W is the working capacity of the machinery (in hectoliters of cones per hour;

S amount of seed required each year (in kilograms)

F average frequency of seed crops (in years)

Y seed yield (in kilograms) per hectoliters of cones or fruits

P working period (in days)

T daily working time (in hours).

On the basis of this formula and given the following data, the resulting output per hour would be 1 hectoliter.

Amount of seed required each year	=	1,000	kilograms
Average frequency of crop	=	3	years
Total amount of seed to be prepared in seed years	=	3,000	kilograms
Seed yield per hectoliter of cones or fruits	=	2.5	kilograms
Corresponding amount of cones or fruits to be processed	=	1,200	hectoliters
Working period	=	100	days
Output per day	=	12	hectoliters
Daily working time	=	12	hours

For small amounts, it is often more economical to prepare seed by hand or with very simple equipment. But for very large seed production, all modern machinery and auxiliary equipment will greatly reduce costs: mechanical elevators, transport bands or blowing pipes give positive results and often allow a better handling of the seed. Sometimes, a choice must be made between a certain number of small plants placed in the forest and dealing with a limited amount of seed from the local provenances or a large central plant, handling seeds from a wider area.

Such small plants, where work is usually done by hand, could be equipped with relatively simple machines which reduce time and transport costs; they are preferable for species requiring quite simple handling.

Large central plants are run more economically if very large amounts of seed are to be produced, especially for species which require a long series of difficult processes. In a large plant it is possible to establish all types of equipment, even if very expensive. Full mechanization and automatic control ensure good organization of the work and eventually a continous working cycle with an increase in the daily output of the plant.

Of course, such plants demand a large capital investment, and costs should be carefully studied. It is probable that they are profitable only if the yearly production can be estimated at several thousand kilograms of seed.

Preliminary Operations Precleaning and Storage of Fruits

Cones or fruits, after transportation from the collecting place to the working plant, should be cleaned before going to the kilns or extractors, or to the stores, since they are often mixed with pieces of bark, wood, and twigs or other impurities.

This rough cleaning may be done by flat (Figure 7) or by rotating screens.

Another method of precleaning is by flotation: damaged fruits and impurities come to the water surface and can easily be skimmed off. But the commonest method is the use of oscillating screens or vibrators.

For seeds of some trees, as *Carya*, *Juglans*, *Quercus*, *Ulmus*, cleaning is the only handling required.

FIGURE 7. – *Flat screen for cone cleaning before storage.* Courtesy, Morandini.

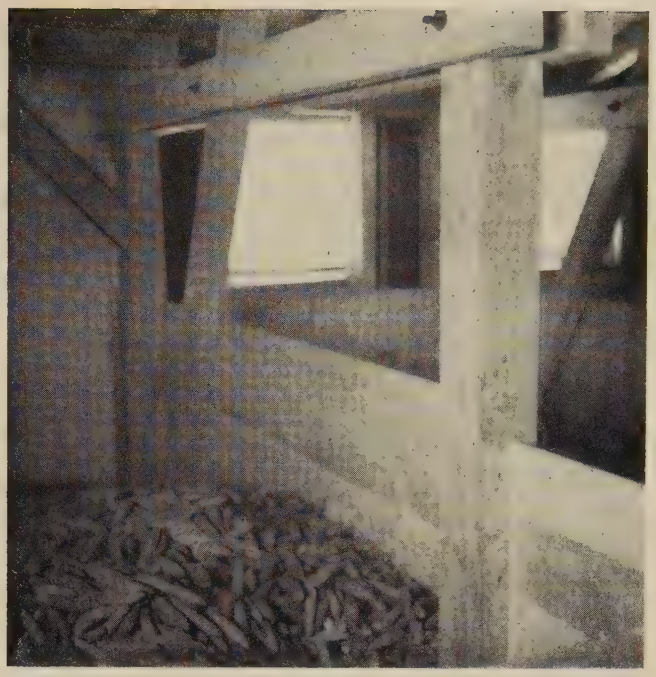


FIGURE 8. – *Compartments in a cone store.* Courtesy, Morandini.

Storage of fruits or cones should be planned with care. Many fruits, especially conifer cones, need a period of storage to become completely ripe. If a large amount of any fruit is collected in a very short time (for some species the collecting season is not more than two weeks since seeds fall quite early when ripe) it may be necessary to store it for some months, depending on the working capacity of the plant.

Storage accommodation should always ensure proper air circulation, and strictly avoid any stagnation or humidity, or very sudden variation in air temperature. Cones or fruits should never be placed directly on concrete floors: wooden or brick floors are recommended. Windows should be without glass but protected by shutters. Nonmetallic roof covering is preferable.

A many-storied building is usually better as elevators or other equipment allow easy transportation between different floors. Floor surface should be divided into compartments (Figure 8) each containing fruits or cones of a single provenance; to assure an easy separation of provenances, the area of each compartment should not be more than 8 to 10 square meters. Cones or fruits should be stored in thin layers (no more than three or four times their length) and stirred very often. Sometimes a part of the compartment floor is easily moved (or opened), so that fruits may fall down to the floor below.

The total area of the store depends on the amount of fruits to be handled, on the duration of storage, and on the working capacity of the seed extractory. If many species are worked in the same plant, one should bear in mind that their collection times are often different: the storage surface could then be reduced. In central Europe, for example, spruce cones are collected in September-October, while those of larch and pines are collected much later, sometimes even in winter. By the beginning of the collection time for larch, a large proportion of the spruce cones will have been already handled, and the space in the store emptied.

METHODS, PROCEDURES AND EQUIPMENT FOR EXTRACTION

The separation of the seed may be obtained by purely mechanical means, such as threshing; by maceration (fleshy fruits); or by drying the fruit. The last is the more frequent case, almost general for conifers, whose cones should be dried to get their scales open and release the seed.

DRYING FRUITS AND CONES

All fruits (including cones), have at their full ripeness a variable but always high moisture content. For example, in cones of some pines this varies between 35 and 65 percent. In natural conditions, fruits on the trees are largely exposed to heating by the sun, and to open air movement; both, but especially the second agency, provide a progressive drying of the fruit, which eventually causes the splitting of the fruit envelopes (i.e., beech or chestnut), or the opening of the cone scales (i.e., *Pinus* spp., *Picea* spp.), or the disintegration of the whole cone (i.e., *Abies* spp., *Cedrus* spp.). The speed of this process depends upon the climatic conditions and the local weather, and its duration varies greatly according to the species. Cones of *Abies* disintegrate just as seeds are ripe, while the same process occurs in *Cedrus* spp. only some months later. Spruces open their cones and seed falls early in autumn, while cones of larch and of many pines remain closed till late winter. Of course any variation of the local weather can change

the atmospheric conditions and induce cones to open. In foggy, rainy autumns spruce cones too remain closed till very late, but a few dry, windy days make them open quickly.

Artificial drying should reproduce as much as possible the natural process. Fruits should be submitted to progressive drying by a continuous release of moisture from the fruits. Air coming in contact with fruits should be always drier than the fruits. This can be obtained by circulation of air, either artificially heated or unheated.

Drying in the air

The circulation of air at room temperature is sufficient to open and disintegrate cones of *Abies* and *Cedrus* spp., and separate seeds of some hardwoods, such as beech or oak, from their hulls or coverings. Fruits, which are placed in thin layers on the floor (which should be of wood or bricks, not of concrete) or on canvas, in a well-ventilated room, should be stirred frequently to avoid any moisture stagnation. The stores described for keeping cones or fruits could very well be used for air-drying too.

This method is used for very small amounts of fruits, which do not warrant any special equipment, and for species which could be damaged by any heating, including sun heating. It is commonly used for *Abies* spp. Depending upon the atmospheric conditions, its duration is often very long, and in a wet season a good deal of work is called for in stirring cones frequently.

Drying in the sun

This method of drying is still largely used: it is convenient for occasional operations, but for some species it is commonly used for regular operations too. This was of course the first method followed in fruit drying. Fruits are placed in layers on platforms or on screens, and exposed to the sun. Mediterranean pines, such as *P. pinea*, and *P. halepensis*, are always handled by this method. Medium-sized cones, such as those of *P. pinaster* or *P. halepensis*, are placed on a platform (of pressed soil, or bricks) in a uniform layer 10 to 15 centimeters deep, stirred frequently, and exposed to the sun until scales open; a cover is spread over the cones in bad weather. As cones open, they are shaken on the platform, and seed is collected on it. Cones of *P. pinea* are placed in long rows, piled about 50 centimeters high. Open cones are gradually collected from the upper layer of the row and are ready for tumbling.

Other species are exposed to the sun on wire screens with meshes of suitable size to let seeds drop through onto a canvas spread under the screen. If local climate is quite cold and damp at night, screens should be removed and put under cover. A glass is sometimes placed over the screen, to protect cones against rain and to avoid the dispersal of sun heat; but this method is rarely used today since it requires too much labor, and glass may cause overheating of the cones with damage to the seed.

Cones of most species generally open in the sun in a relatively short time: white and yellow pine and Douglas fir require from three to eight days; but other species could require more than one month. Some species such as lodgepole pine, open so irregularly in the sun that artificial drying is recommended.

Drying is easy during spring and summer, but during autumn and winter when most cones and fruits ripen, it can be carried out only in hot dry regions. There, it is often very convenient, since it does not require expensive installations; but where the weather is changeable, artificial heating is more convenient, as it permits normal work irrespective of weather conditions.

Drying in heated kilns

Drying in heated kilns is used mostly for cones of conifers, and therefore only cones will be dealt with here, although some other fruits can be handled in this way.

The main difficulty in drying cones by natural methods is the absolute impossibility of controlling air humidity and temperature. An increase in the humidity of the air may cause a reclosing of the cones and sometimes a consequent "case-hardening," i.e., cones do not react to further drying but remain closed. Artificial heating, on the contrary, permits control of air moisture and temperature, a much shorter handling time is required, and the process can be continuous so that work organization becomes more effective. Of course, artificial heating requires installations and equipment which are often very expensive. Permanent extraction plants with such equipment should therefore be established only if enough seed is obtained to make the investment pay.

Small drying units mounted on trucks have been tried in the past. The first one was constructed at Eberswalde (Germany) in about 1930; this unit could be moved from one forest to another, and could extract separately the seed of each local provenance, thus bringing about some reduction in the transportation cost. Recently, infrared equipment has been tested to dry cones on the truck. But permanent units are on the whole more effective and seem to be more economical.

Cone drying by artificial heat should be carried out in such a way as to obtain drying in the shortest time, without damaging the viability of the seed. For this purpose, the following recommendations should be carefully observed.

1. Cones should be properly cured before they are put in the kiln.
2. Air temperature should be controlled and kept to the minimum level sufficient to dry cones.
3. Cones should not be heated longer than necessary.
4. Air in the kiln should be kept as dry as possible.

Moisture and temperature controls are of the utmost importance. The ideal handling would be to expose the cones to a flow of air, whose moisture content should decrease gradually, thus getting a regular, progressive drying and opening of the cone scales.

Temperature and moisture control

Heating increases the saturation deficit of the air, thus obtaining a further release of moisture from cones. But air temperature must not rise above a certain limit, beyond which seed viability in seriously damaged. Generally, temperatures of 40°C to 50°C may be reached. Such temperatures, however, are only allowed if the air humidity and the cone moisture are very low, a combination occurring only at the end of the drying process. At the beginning, hot air acting on wet cones would cause scalding of the seed.

In the past, decreasing temperatures have occasionally been used: but in modern extraction plants either constant or increasing temperatures are employed. Moisture control could be obtained by chemical means, forcing air through filters containing drying materials, but heating is generally much easier and cheaper and it is almost always preferred.

Air heating. This can be obtained by different methods, any source of heat being suitable. In large extraction plants any kind of fuel can be used, including emptied cones or other wastes of extraction. Modern plants often use oil, since it insures a more regular combustion and a completely automatic temperature control. Sometimes electric heating is employed, but it is very expensive and is therefore used only for very small dryers, e.g., for laboratory units.

The control of air temperature is relatively simple in modern plants. A thermostat located where the air enters the drying room can stop or slow down the heating, or permit a flow of cold air to enter and reduce temperature. In old plants temperature is controlled by the operator. Thermometers and thermographs allow the operator to follow the variation of temperature inside the kiln; they should be connected to an alarm bell which rings when a critical temperature is reached.

Air humidity. The control of air humidity is much more difficult: hygrometers and hygrographs can record the humidity variation, but it can be regulated inside the kiln only by forced ventilation. As already mentioned, seed may also be damaged by relatively low temperatures when humidity is high, so that every possible care should be taken to avoid any stagnation of moist air in the kiln. Modern extraction machinery is generally based on a continuous forced ventilation, but in the case of old types of extracting machinery the air change is only periodic or sometimes completely absent.

According to Toumey and Korstian (1954), the relative humidity in the drying room should be kept lower than 50 percent during the early period of drying and below 10 percent at the end of the handling.

Precuring

Cones or fruits are collected as they appear to be ripe, but since natural seed dispersal often immediately follows full ripeness, collection starts before ripeness, particularly if a large amount is required.

Fruits do not all ripen at the same time, however, even for the same species and in the same forest. Consequently, many fruits or cones are not fully ripe when they reach the extractory. They can be ripened by storing in thin layers and in well-ventilated rooms. The longer this precuring period lasts, the more complete is the cone ripeness and the better is the seed quality. It has been found that the shortest time to get good results is two weeks, but many species demand more than six or eight weeks.

Precuring avoids the case-hardening of cones which lose from 10 to 50 percent moisture according to the length of the precuring period, thus facilitating and shortening the drying process in the kilns. This saves fuel and considerably reduces handling costs. Just before the cones are passed into the kiln precuring can be carried out effectively by setting the cones in a local store situated near the top of the kiln, where air from the exhaust, still warm, passes through.

Types of kiln

In the past many types of kiln of local design and construction have been used but they were often only suitable for local conditions.

Modern installations present a large variety of types, which fall broadly into two major categories: progressive kilns and rotating drum kilns.

Progressive kilns. In this type of kiln, cones are exposed to an air flow getting hotter and hotter, and drier and drier, from the beginning to the end of the drying period. Schematically, the cones are placed in the kiln on a set of trays, one above the other, in a sort of tower; trays descend during cone treatment. From the bottom of the kiln the hot dry air hits the lowest tray, containing fairly dry cones; passing through the cones, the air loses some heat and takes some moisture from the cones. In the second tray, from the bottom, cones have somewhat higher moisture content and the air is less hot and less dry. In the last tray, the cones, still having the original moisture content, are engulfed by warm, humid air.

At the right moment, a tray is taken away at the bottom, and the whole tray set descends one step, while a new tray with fresh cones is put on the top of the pile.

Hot air can circulate simply by convection, but forced ventilation makes the operation quicker and more regular. The distance between two successive trays should be sufficient to contain open cones which have a volume 2 to 3 times that of closed cones. The time required for complete drying varies according to the initial moisture content of the cones, the volume of circulating air, and the type of air circulation (convection or forced ventilation). For some species (i.e., *Abies* spp.) heating is harmful, and drying is obtained by forced circulation of air at room temperature.

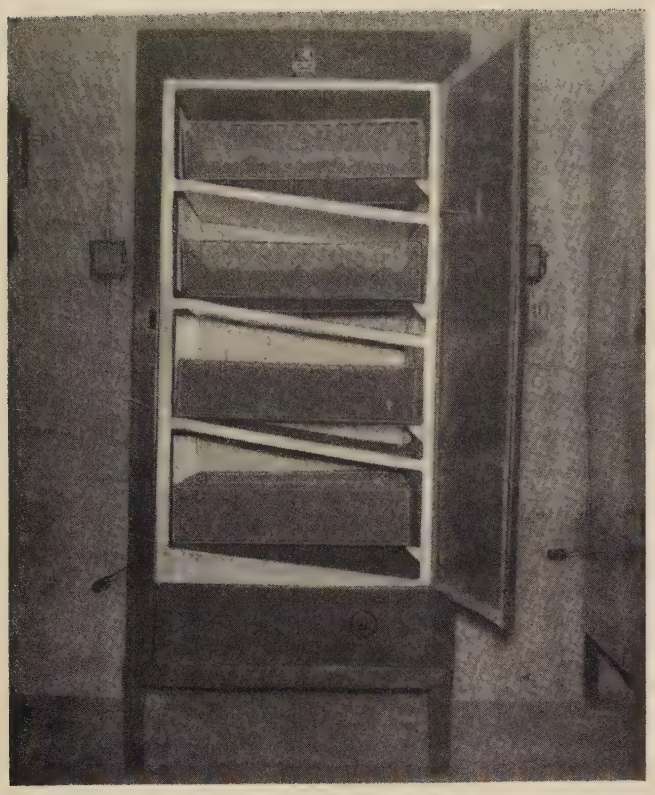
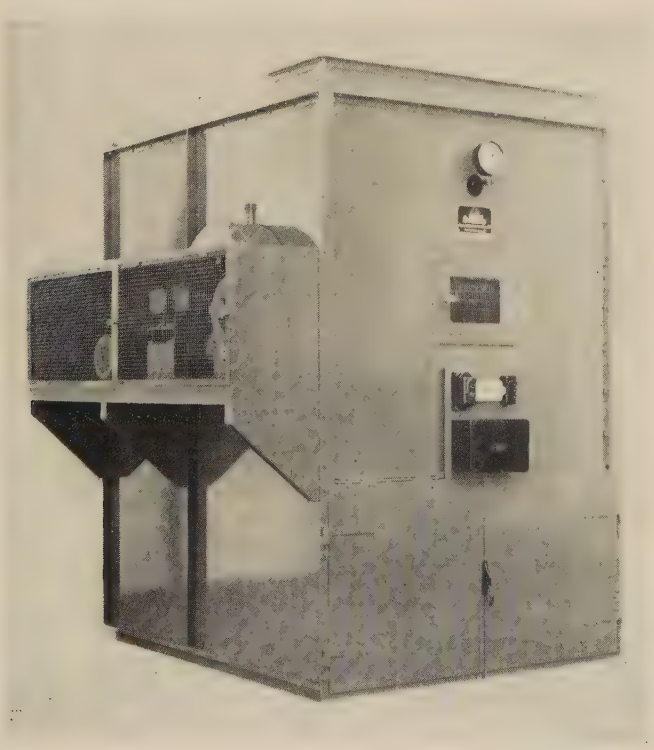


FIGURE 9. – *Full view of kiln showing trays filled with cones. The hot air flows in through the slot in the bottom right hand corner of each tier, passes through the cones and leaves by the slot in the top left hand corner.*

FIGURE 10. *Type of rotating kiln.*



In some kilns, cones are forced to fall down from one tray to the one below by opening the tray bottom, or by inclining the tray. In other types, trays are replaced by slow moving bands: cones move on a band till they fall to the one below.

In the last two types, cones are shaken as they fall from tray to tray, so that most of the seeds come out: special devices under the bottom tray collect the seed, while cones pass to further handling.

Similar working schemes are applied in some small extraction units, planned chiefly for laboratory extraction (Figure 9). The Forest Experiment Station of Mariabrunn (Austria) has developed a small kiln of this type to extract seed from cones of individual trees, as well as to carry out experimental seed extraction to test the seed yield. This type usually has electric power heating.

Some kilns have just one or two trays, which may be opened: from the lowest, cones fall into a drum, where they are tumbled while still drying. This is the method used in some old and very large extraction plants, still operating satisfactorily. At Wolfgang (Germany) four such "towers" could extract all the conifer seed required in the Federal Republic.

Rotating drum kilns. Cones are put in a cylinder made of perforated steel plate, rotating on a central axis. The cylinder is contained in a box, where forced air circulation is provided by an electric fan. During the extraction the cylinder rotates continuously, shaking the cones. The air temperature increases gradually, from room temperature to the maximum fixed level. The strong ventilation, the progressive heating and the continuous shaking make the cones dry and open in a short time. Seeds released from cones pass through the holes of the plate, and are blown at once out of the kiln. Temperature and ventilation control is generally fully automatic.

This type of kiln offers many advantages, and is usually preferred in modern extraction plants. The time needed for seed extraction is greatly reduced; the shaking of cones during drying causes the cones to open and the seed to fall. Separate tumbling is unnecessary, and labor and time are saved.

Seed is taken out of the hot air as soon as it comes out of the cone in order to avoid seed damage. The capacity of the cylinder is reduced so that extraction can be done separately for cones from different provenances, even if the quantity is small. Kilns of this type may have electrical heating or a separate heating unit (Figure 10) which can use different fuels (cones, coal, oil).

The cylinder, the electric motor, the ventilator and the equipment for air and temperature control are contained in a steel box above which is a predrying box with two floors. From this box, cones fall into the cylinder, where they are exposed to increasing temperatures (40-45-50-55-60°C) for three to four hours. At the end of the extraction, reversing makes the cylinder

open: emptied cones fall down, and other cones come into the kiln (Figure 11). This type has a working capacity of 25 to 30 hectoliters of cones per day.

Modern rotating kilns are generally of compact metal construction, moderate in size so that they can be placed in small, inexpensive buildings. The output is relatively low as the capacity of the cylinder is of 3 to 4 hectoliters. These kilns are generally planned for working in a set of two or three, so that they are suitable for plants of different sizes. Their moderate cost is also a factor which makes them suitable for use in small plants.

Occasional drying methods

For small amounts of cones, and especially for occasional operations, drying can be obtained by very simple means. A room with any source of heating is sufficient. If possible, cones should be spread on single trays, and placed near, but not too close to, the source of heat. Doors and windows may be opened carefully or appropriate holes made in them to ensure proper air circulation. Heating should be kept low and cones should be frequently stirred. When such primitive treatment is adopted, any haste may cause damage to the seed, because safe drying can be obtained only by a very limited heating and therefore takes quite a long time.

Kilns constructed for other purposes, such as lumber-drying or hop-curing kilns, can be used for cone drying cheaply and with good results. Of course, care should first be taken to see what facilities they have for the control and regulation of temperature and humidity.

Fire danger

Any artificial heating involves, of course, a fire hazard. This is particularly true in handling cones, which always contain resin, often in large amounts; besides which, the cone scales themselves are, when dry, very inflammable. Great care must therefore be taken. No heating of any kind should be allowed in the cone store. In the extractory plant dust, which consists chiefly of particles of cones and resin, should be removed, especially near the kilns. In modern plants, this can be done by a vacuum equipment. Pneumatic pipes suck the dust from the interior of the machines into a special container.

The building where drying equipment is installed should be of masonry, and wood should never be used in the construction of the heating and kiln compartments. All measures should be taken to prevent and control possible fires, such as the provision of extinguishers and the instalment of iron doors.

TUMBLING

When cones open after natural or artificial drying, not all seeds are detached from the scales and fall out; some are usually left inside the cone. Seeds of some species fall easily after a thorough shaking, but cones of others require a severe and prolonged jarring. The method by which cones have been dried makes a great difference. Adequate precuring, regular drying, and no excessive heating ensure a more complete opening of the cone scale and an easy seed release.

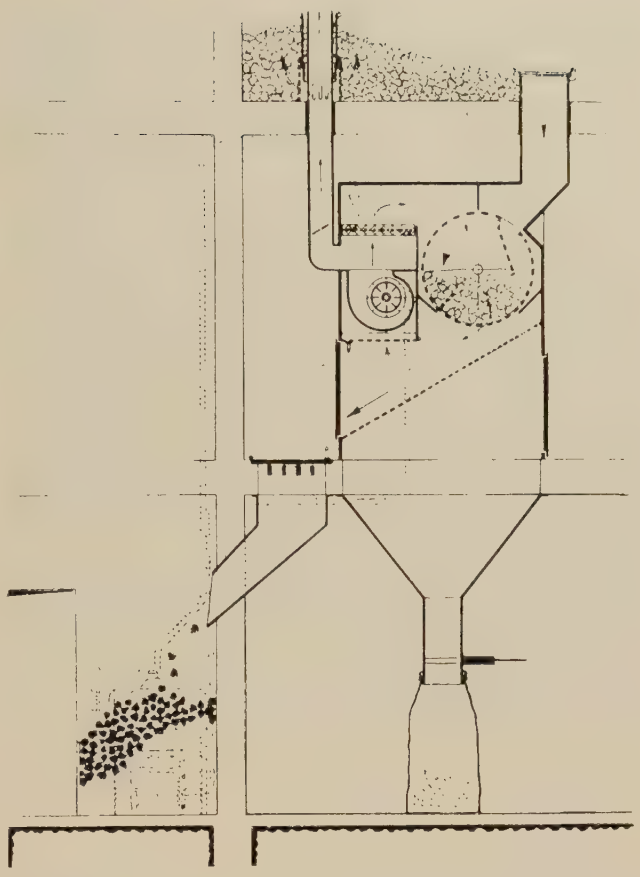


FIGURE 11. – *Working plan of the rotating kiln shown in Figure 10.*

After drying, especially by heating, the seed should be removed from the cone as soon as possible, because open cones exposed to cold, wet air, can reclose in a short time. It would be wise to keep dried cones in a warm room until all seed extraction processes have been carried out.

In order to separate seed, cones are put into a drum or tumbler, which is a barrel or cylindrical or rectangular box, rotating on a central axis; the walls of the barrel or box are generally of wire mesh large enough to let seed pass through. As the drum revolves, the cones are thrown against the walls, more or less violently according to the revolving speed, while the seed comes out of the cone and falls through the wall meshes into a collector.

The process is carried out in the same way as in the cylinder of rotating kilns. The drum may be closed at both ends, and filled and emptied at the end of each operation cycle (Figure 12). In modern types, reversing makes the cylinder open; in other types the drum is open at both ends and is quite long, with its axis somewhat inclined so that the cones are fed in at the upper end and, during rotation, roll slowly to the other end, where they fall out (Figure 13). Such a drum gives a

FIGURE 12. – *End view of extractory cone drum showing the starter and enclosed chain drive.*

continuous operation cycle, but the rotation speed must be slow, with the result that the vibration may be inadequate for some species.

The walls of the drum are sometimes of thin bars, placed very close together.

All such drums can be operated by hand or by a motor; the turning speed can vary according to the species. Small types are easily transportable, and can be used for very small amounts of cones in occasional operations. In these cases, some devices similar to those used for agricultural crops may also give satisfactory results.

If no equipment is available, seed extraction can be obtained by flailing open cones on a floor; in the case of very small cones, they are put into sacks before flailing.

For species with very small seeds, such as *Tsuga* and *Cupressus*, a little revolving box is used: light wooden frames support a mosquito wire net. The box rotates on its axis, just as in larger tumblers, but for these species a few rotations suffice to extract all the seed.

THRESHING

Seeds of some species, such as *Liriodendron*, *Catalpa* and *Cercis*, can be extracted easily from the fruit. Their pods are flailed on a platform and generally break without difficulty. For large quantities mechanical threshers are used. Generally, threshers used in agriculture for similar types of fruit can be easily adjusted by altering the distance between the crushers. The other operations follow in the usual way.

The cones of some conifers, especially some pines, do not open completely even after a long drying, and even tumbling is not sufficient, so that further mechanical handling is needed to extract the seed still remaining in the cone. After sun drying, cones of *P. pinea* are treated in large threshers, so that the scales detach quickly and completely from the cone axis. Larch cones are often difficult to open as they have a very high resin content and the resin melts at a temperature lower than that sometimes required to open the cone. After partial drying, therefore, the cones are crushed in special mills.

In stationary or rotating kilns, the cones, after normal drying, fall into a cylinder equipped with a series of knives: fast rotation provides both tumbling and cutting of the cones at the same time.

For some fruits, hammermills are used, always with the aim of breaking the casing of the fruit. Again, hammermills used in agriculture are quite effective and suitable.

The processes of tumbling, threshing, crushing or cracking can cause damage to the seed, thus inducing an abnormal seedling development or an early loss of the germination power. These mechanical processes should be carried out carefully, the intensity of shaking and flailing being proportionate to the hardness of the seed walls. It is better to leave some seed inside the cones than to risk severe damage to the seed.

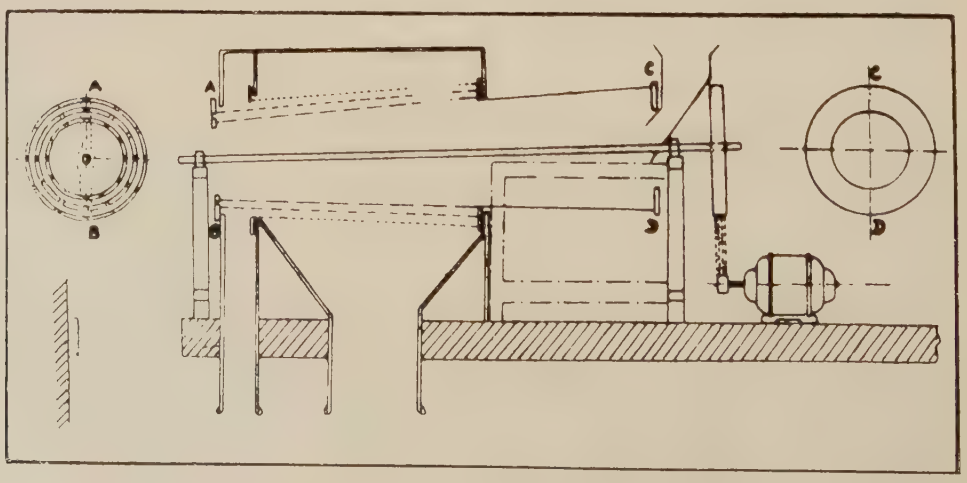


FIGURE 13. – *Rotating cone tumbler.*

DE-PULPING FLESHY FRUITS

The fruits of many species, such as *Juniperus* spp., *Prunus* spp., *Malus* spp. and *Rhamnus* spp., are fleshy or semifleshy.

Some of these fruits (i.e., *Juniperus* sp.), may be dried just before storage, drying being effected by natural or artificial heat. But safe storage usually requires separation of seed from the pulp of fruit: this can be obtained by macerating the fruit in water. Fruits are left in open containers until the pulp becomes soft and decays; they are then placed in water (often some lye is added), stirred and mashed. After a certain time, the seed separates from the pulpy parts, and sinks to the bottom: after proper drying (preferably by unheated air) the seed finally goes to cleaning or to storage.

Some special machines have been developed for de-pulping fleshy fruits and adapted hammermills, corn-shellers and macerators have also been used. A small portable type of macerator consists of a plate spinning at the bottom of a seed hopper: pulps are washed out through an appropriate outlet, while seed is retained.

METHODS OF EXTRACTION BY CLEANING

Many fruits are quite ready for sowing as they are collected, or just require the separation of seed from the casing. Beech, oaks, chestnut, and hickory require only a very rough cleaning, which can be done by winnowing, screening, or some other very simple method. These seeds are often extracted by hand, or handled in a separator normally used for agricultural products. Almost all the abovementioned machinery can do an effective job provided the size of the seed is taken into account.

Methods, Procedures, and Equipment for Cleaning Seed

Seed which has been extracted by the various methods already described requires further handling before storage. Wings or some other parts of the fruit may be still attached to the seed, and many impurities of different types are always present. Cleaning provides a thorough separation of pure seed from inert matter and from shriveled and empty seeds, and prepares it for storage and sowing in the best condition. The species and the amount of the seed will determine whether cleaning is best carried out by hand, by improvized equipment, or with the aid of special machines. De-winging, fanning, screening, and separation are often needed to obtain seed of good quality. As a general rule, the aim of cleaning is to get completely pure seed, but this is not always possible. On the other hand, there is often no particular advantage in cleaning beyond a certain limit.

Modern machinery has reached a very high degree of efficiency in this field, but in many cases, complete separation would cause a loss of seed. In the case of larch, for instance, the seed should not be cleaned to a purity higher than 65 percent as it has been proved that further cleaning causes a drastic loss of good seed.

DE-WINGING

Many forest seeds, and almost all those of conifers, are winged. In some species, e.g., *Pinus pinea*, the wing is quite rudimentary or very short, but in others it is long and hard. Sometimes the wing completely covers the seed (*Abies* spp.).

For some species it would be preferable to store a seed with its wings in order to ensure a better air circulation. On the other hand, sowing winged seeds may cause many difficulties: they may be blown away or more easily picked up by birds, and the use of sowing machines may be impossible. For these reasons, the wings are always removed whenever they are larger than the seed.

De-winging is almost always carried out by rubbing. In the past, seeds were spread on a floor and sometimes lightly moistened by sprinkling them with water, after which, flailing by light leather flails was sufficient to remove wings. This method is no longer used, because it involves the risk of fermentation of moist seed or the development of fungi.

Hand rubbing the seed in a sack is the safest method, but it is practicable only when small amounts of seed are involved. Many types of de-winging machines have been developed and are in use, from the simplest types, which are operated by hand, to those suitable for large plants, which work semi-automatically, and give a continuous output. They are almost all rotating devices.

Rotatory de-wingers may have brushes or knobs. In the first type seed is pressed by brushes moving

FIGURE 14. – *Rotating de-winger with rubber knobs.*

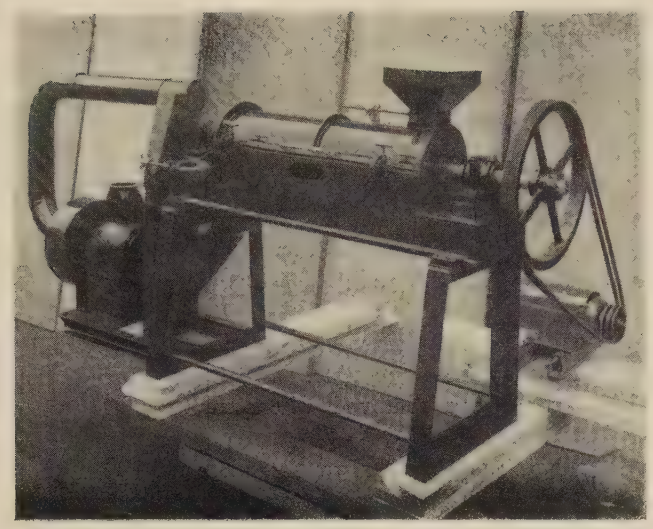


FIGURE 15. – *De-winger.*

against the walls of a cylinder. In the second type rotating knobs or pads force the seed to pass through narrow outlets, and leave the wings. The distance between brushes or knobs can be regulated according to the size of the seed. Brushes may be of steel, nylon or tampico, which have different degrees of hardness; cylinder walls may be of corrugated wire or perforated plate, or lined with canvas or rubber.

A de-winging machine may be a drum of webbing revolving in a hammock of the same material. Another de-winger (Figure 14) is made with rubber pads rotating in a rubber cylinder. Figure 15 shows a modern de-winger which is used in many German plants.

If the clearance between knobs or brushes and the walls is too narrow, or if the brushes are too hard, the seed may be damaged either by pressure which breaks the seed coat; by scarification; or by heating caused by friction. Great care should be taken to avoid this. The main difficulties to be overcome are: a proper regulation of the clearance; the settlement of the best revolving speed; and the attainment of a regular seed supply.

For some very sensitive seeds, cleaning before de-winging is recommended, to remove any particle of hard material which could injure the seed coats during handling.

CLEANING OPERATIONS

The different cleaning operations may be carried out separately or at the same time. Modern cleaning machines often combine different handling methods so that the cleaning process may be both effective and quick. These operations are given below.

Fanning or winnowing

A strong air current blows away light impurities, cone particles, dust, empty seeds, while good seed and heavier particles are not removed or fall down at once. Winnowing is often carried out, especially in agriculture, by throwing seed into the air on windy days. In winnowing machines the air current may be either horizontal and blow through the seed which falls gradually, or vertical and blow across a moving screen on which seed passes.

Screening

Largely used in many separating operations: by passing through screens with meshes of different sizes, the seed is separated from impurities which are larger or smaller than itself. Screens may be of metal net or of perforated plate. Shaking screens are often used. Screens generally work in series of different mesh or hole size.

Separation by centrifugal force, or by vibration

If seed is centrifuged in an open cylinder, heavier particles go up first along the walls and escape: variation in rotation speed provides progressive separation of the particles of different weight. The same effect is obtained by vibration.

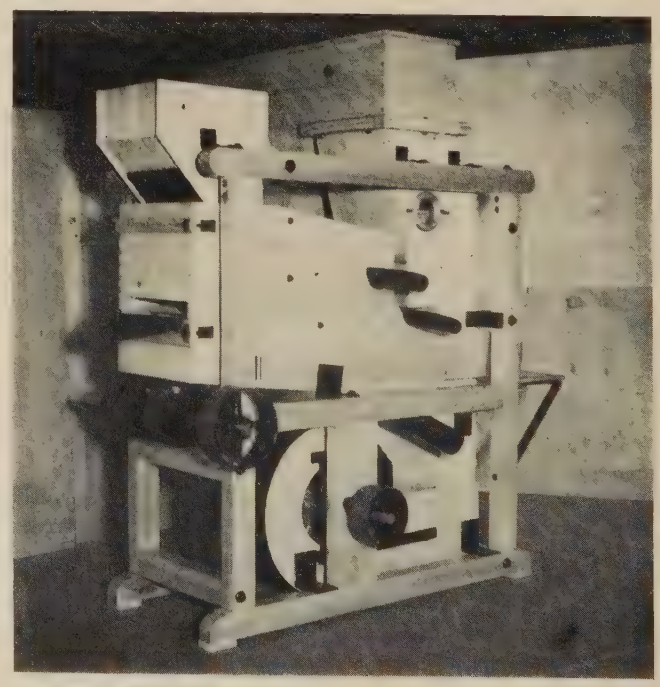
Flotation

When put into water, good seed sinks, while light impurities and empty seed float on the surface and can easily be skimmed off. This simple separation method requires a subsequent seed drying, but it is very effective with some species, such as acorns.

Combine cleaners

Cleaning methods separate good seed from undesirable impurities or empty seeds in three ways: by size (screening); by specific gravity (flotation, vibration); and by

FIGURE 16. – *Combine cleaner.*



centrifugal force. These different methods are often combined in modern equipment. Screening and winnowing are almost always used, and sometimes carried out simultaneously. There are many such machines (Figure 16).

Mechanical shaking and separation by air blowing are used, a vibrator type seems to be especially effective in cleaning larch seed. For hardwoods, fanning mills have been developed. Vacuum and cyclone systems have been successfully used in cleaning seed, but up to now such special handling methods are rarely used.

Conveyors, Baggers, and Other Transport Equipment inside the Seed Extractory

All material, from the rough fruit or cone to the fully cleaned seed, should pass from one handling to the next quickly, in order to avoid any possibility of contamination or mixture with undesirable matter, and any remoistening which would necessitate further processing.

Transport should be done as far as possible by mechanical means: conveyors, transport bands and blowing pipes should be used in the different phases of handling, depending on the size and the type of material. In general, cones are transported by chain elevators or by bands; for seed, blowing by pipe is very convenient. These blowers should be self-cleaning, in order to avoid any possibility of mixtures, chiefly between seeds of the same species but from different provenances.

All handling, but especially tumbling and cleaning, produces a large amount of dust. De-dusting apparatus should be connected to all transport equipment, as well as to all handling machines. Vacuum pipes should collect all dust from where it is produced, inside the kiln, inside other machines or at their air outlet, and convey it to a cyclone and a special cell. This keeps the work room clean all the time and makes working conditions safer. Transport equipment should carry cleaned seed up to the store. Packaging into containers for storage or for shipping could also be done by automatic bagger.

Moisture Control in Drying

Seed should be kept dry during all the different stages of handling, but particularly at the end of the process, where it is prepared for storage or shipping.

Seed handling should be carried out in a warm, well-ventilated room. In effect, many cleaning machines use the heated air coming from the kilns, thus insuring a continuous drying process. But, in any case, before storing or shipping seed, moisture should be checked and especially if the seed is to be stored in closed containers.

Testing the actual seed moisture is rather difficult. Laboratory moisture testing may give very exact results but always takes rather a long time. Furthermore, the specialized staff required is not normally available within the seed extractory. In practice, testing should quickly give the moisture content of seed at the moment of packing. For this purpose, some electronic moisture testers have been developed, based on the electric capacity or resistance; some types give the degree of moisture of seed inside the container. Infrared moisture balances are also used. All the abovementioned testers give results by direct reading but their precision is somewhat limited: further development of such apparatus is desirable.

In storage, seed should have a low moisture content (generally of 5 to 10 percent); if necessary, it should be carefully dried by submitting it to a dry draught of air. For this purpose almost all types of stationary kilns, or even a simple winnowing machine, should give immediate results. Temperature should be kept very low, however, and for some species (i.e., *Abies* spp.) any heating should be avoided.

(*To be continued*)

The Forestry Commissioners in the United Kingdom announce that they have appointed *Sir Henry Beresford-Peirse* as Director-General of the Commission with effect from 1 April 1962. Sir Henry has been Deputy Director-General for the past nine years. He joined the Commission in 1929 and was Director of Forestry for Scotland from 1947 to 1953. For the last two years he has been seconded to the Forestry and Forest Products Division of FAO in Rome as Deputy Director, and his departure will be a great loss to the Organization.

The Work of FAO

North American Forestry Commission

In view of the desire of the governments of Canada, Mexico and the United States of America to arrange for the discussion of forestry matters of mutual interest in a more systematic and co-ordinated manner than was possible under existing informal arrangements, the Tenth Session of the Conference of FAO decided in 1959 to establish a North American Forestry Commission. The first session of the Commission was held in Mexico City from 24 to 29 July 1961, at the invitation of the Government of Mexico and laid down the lines which its future activities should follow.

Under the chairmanship al Dr. Enrique Beltrán, Undersecretary for Forest Resources and Wildlife, Mexico, the commission received brief statements from each delegation broadly setting out the areas of immediate interest and the principal forestry and forest products problems of their countries. J.D.B. Harrison, Deputy Minister of Forestry at Ottawa, spoke for Canada and Richard E. McArdle, Chief of the U.S. Forest Service, for the United States of America. It was agreed that any financial obligations arising from the activities of the Commission in tackling these problems would be met by the Member Governments, and Sir Henry Beresford-Peirse, Deputy Director of Forestry and Forest Products Division, explained how the FAO secretariat would provide liaison services.

Forest insect pests and diseases

One of the principal problems dealt with by the commission was that of forest insect pests and diseases. M. L. Prebble of Canada summarized the position as follows:

(*a*) With respect to general exchange of information and biological materials among forest entomologists and pathologists, numerous channels were already in existence as regards the United States and Canada,

(*b*) In pest problems requiring control action in two or more North American countries — by direct means, biological control measures, or the administration of plant protection legislation and accompanying regulations — the commission would be the suitable body to formulate recommendations on control policies,

(*c*) In the field of intercontinental co-operation on forest insect and disease problems, the commission should be able to promote full participation among North American countries and, through other regional forestry commissions of FAO, secure collaboration also by countries in other regions on problems of broad international significance. It would be advantageous to enlist the co-operation of other international agencies such as the International Union of Forest Research Organizations (IUFRO), which has already promoted large-scale collaboration on forest disease problems.

As a result of its discussions, the commission decided to create a working party on forest insects and diseases to prepare an analysis of the principal problems in the region; indicate which problems are of immediate concern, and suggest priorities among these problems for study and action. If the members of the commission agreed before the next session that the analysis and priorities constitute satisfactory terms of reference, the chairman would authorize the working party to proceed forthwith with an action program.

Forest fires

J. N. Diehl of the United States delegation described the forest fire problem of the region in its three main aspects: prevention, control technology, and research, and gave examples of past collaboration between the three countries. He suggested that a working party on forest fire control should also be set up to:

(*a*) promote sharing of the latest fire prevention " know-how " and materials;

(*b*) provide ways of achieving a better exchange of information on improved fire control techniques, equipment use, and new developments in equipment design;

(*c*) recommend interchange of services in fire control of advisory, consultant or training experts, where feasible and desired;

(*d*) facilitate the sharing of fire weather data, fire danger rating forecasts, whenever applicable and desired;

(*e*) foster mutual correlation of plans for a research program and identification of the most urgent research needs;

(*f*) encourage prompt exchange of the results of fire research, progress reports and completed publications;

(*g*) further the adoption of international forest fire control compacts and agreements, whenever and wherever needed and desired;

(*h*) assist, when requested, in the preparation of national legislation needed to implement mutual aid in forest fire control among the North American countries;

(*i*) report at each session of the commission on progress and make recommendations to the commission for action on those matters deemed appropriate.

Discussion by the delegates brought out the existence of certain activities of collaboration in prevention, as for example with the "Smoky Bear Campaign," and in control technology and research. Attention was called to the importance of lightning-caused fires in certain parts of the countries concerned, and to the major significance of man-caused fires in all the member countries. It was felt that research on ways to reduce both kinds of fires should have a prominent position in fire research programs.

The commission finally adopted Mr. Diehl's proposal and invited nominations for membership of the continuing working party.

International trade in forest products

Juan Manuel González of Mexico, the rapporteur of the session, introduced the subject of Mexico's need to increase its manufacturing capacity for forest products, not only to supply the internal market but also to expand exports. Certain difficulties had to be faced in regard to the latter, and the other delegations agreed that further consideration would have to be given in their respective countries before any definite action could be expected from the commission.

Other business

Topics suggested by delegates for consideration at future sessions included the preservation of natural forest areas, attention being called to the current activities of the Society of American Foresters in the United States; forest inventory methods, with emphasis on photogrammetry; forestry and wildlife; forestry and recreation; and the co-ordination of bilateral and multilateral technical aid programs. The commission agreed to draw the attention of universities and other training institutions to the need for foresters who were being trained in international work to be given also training in languages, and in the proper attitudes and understanding necessary to make them effective international experts. The commission noted the value of study tours. Mention was made of the first such study tour organized by FAO, that on fire control methods, for which the United States had been host and to which both Mexico and Canada had sent participants, and of the most recent tour on Latin-American conifers in 1960, for which Mexico had been the host and in which the United States had participated. Travel facilities between member countries of the commission were especially favorable to future study tours on these and other aspects of forestry.

The Canadian delegate called attention to its national Conference on Resources for Tomorrow (held in October 1961) which was designed to reach agreement on principles of conservation and management of renewable resources including agriculture, forestry, waters, fisheries, wildlife, and recreation.

Mexico cited uncontrolled colonization of tropical forests as one of its major problems, resulting in the destruction of potentially valuable forests to obtain only poor farmland for the colonists.

The commission accepted Canada's offer to be host in 1963 for the next session, it being understood that the exact date should be agreed after consultation between the Director-General of FAO and the members of the commission.

Second World Eucalyptus Conference

The Second World Eucalyptus Conference was held at the invitation of the Brazilian Government at São Paulo from 20 to 26 August 1961, following a study tour of one week's duration in the State of São Paulo. Attending were 250 participants from 20 nations. A. Navarro Sampaïo (Brazil) was elected chairman and M. R. Jacobs (Australia) and A. Chebicheb (Morocco) vice-chairmen. Four working languages were used: English, French, Spanish and Portuguese. More than 130 working papers were presented, translated or summarized and discussed.

The week preceding the debates of the conference proper, the delegates were taken on a study tour in the State of São Paulo, by the generosity of the Government and the leading lumbering and wood-using companies. The exceptionally well-balanced program made it possible to visit many plantations, arboreta, experimental forests and wood-processing plants. A detailed report was drawn up by G. Giordano (Italy) and H. L. Malherbe (South Africa).

During the meetings of the conference the technical questions were divided among five main sections, each under a discussion leader.

Section I - Potential value of eucalyptus
Leader: R. M. Alvaranga (Brazil)

Reports received and discussions held in this section brought out the fact that in the course of the last five years eucalypts have increased considerably in importance in the broad forest policies of many countries with a tropical or Mediterranean-type climate. The total area now under eucalyptus plantations exceeds 1 million hectares, of which 800,000 hectares are in Latin America, 410,000 in Africa and 400,000 in the Mediterranean basin, including the Near East.

Brazil, with its 560,000 hectares under eucalyptus, produces annually 19 million cubic meters with a total standing volume of approximately 97 million cubic meters. This is remarkable when compared, for example, with the figures given by Australia, whose total annual production of eucalyptus wood amounts to

approximately 14.6 million cubic meters from a total area of 44 million hectares of eucalyptus forest.

In the Mediterranean basin, the increase in areas planted over the last five years for many countries reaches about 50 percent of the 1956 figures. Certain countries, such as Viet-Nam and Korea, which are new to eucalyptus growing in their reforestation programs, are contemplating planting projects, the size of which it is intended will increase in geometrical progression over millions of hectares during the next five years.

In certain tropical countries, such as Brazil, there is a tendency to replace eucalyptus plantations with tropical pines, which are expected to yield a largely equivalent volume coupled with better quality pulp and paper. Nevertheless it seems that eucalyptus will continue to predominate in reforestation programs in these areas. In any case, the general picture is one in which the planting of rapid-growth forest species is assuming an increasingly important place.

The main eucalyptus species used in most reforestation programs are largely the same as before with no new introductions. *Eucalyptus alba* gives remarkable results in Brazil and its highly selected seed is being produced in great quantities at Rio Claro. It would be advantageous to introduce the species into many countries with a similar climate and soil.

Although the economics of eucalyptus plantations have not always been the object of sufficiently detailed study, it appears from the data furnished by several countries that the returns from capital invested in eucalyptus plantations, with rotations which may run from eight to twelve years, vary from approximately 4 to 10 percent at compound interest.

Section II - Basic problems
Leader: M. R. Jacobs (Australia)

Few points of importance seem to have emerged during the last five years. However, in several countries a start is being made with the production of selected seed and different applications of forest genetics. A very go-ahead team is operating at Rio Claro (headed by Mr. R. F. Guimaraes), and, from what the conference was able to observe in the course of the study tour, much has been achieved there.

The Australian Government intends to set up a special bureau, the Australian eucalyptus clearing house, whose principal duties will be: to collect technical information on eucalyptus and forward it to FAO for periodical circulation to all parts of the world; to collect and preserve, at Canberra, seeds of different eucalyptus species intended either:

(*a*) for distribution on a commercial basis for large-scale reforestation programs, or

(*b*) to be exchanged or sent as a gift to research institutes for scientific purposes.

It was also agreed that it is on national and regional bases that production could best be organized, as well as the control and marketing or exchange of seed for large-scale reforestation programs. Australia, Brazil, and Morocco agreed to take part in such exchanges on commercial or scientific bases.

Section III - Silviculture and influences
Leader: J. F. Lacaze (France)

Increasingly wider use is being made of machinery in eucalyptus plantations. High forest methods are being increasingly adopted and it is in all cases recommended that heavy, low thinning should be practiced.

Considerable progress has also been recorded in plantation protection against termites and other ants.

Finally, the beneficent influence of eucalyptus shelterbelts on the environment and on the adjacent crops has been made the object of interesting practical experimental work in Italy.

Section IV - Utilization
Leader: C. S. Elliot (Australia)

A great deal of work has been done over the last five years on the technical utilization of eucalyptus wood. Findings give ground for considerably greater optimism than in 1956.

Two encouraging facts are outstanding.

1. The doubts raised today regarding the utilization of wood from young eucalyptus plantations were experienced in Australia 40 years ago but it has since been proved that these were unfounded.
2. Although there are differences between the properties of eucalyptus wood from young, rapid-growth plantations on the one hand and, on the other, the properties of mature trees of the same species in their natural habitat, these are only differences in *degree* and do not give rise to really new problems.

In practice, however, although generally speaking its uses are limited mainly to roundwood or small timber, a number of countries have very impressive figures to show for eucalyptus wood consumption. (In Portugal and Chile this runs to several hundred thousand cubic meters.) Among the various uses of roundwood, some interesting experiments have been made with pitprops in Morocco and round sleepers (crossties) in Brazil.

Section V - Future work
Leader: J. J. M. Garcia (Argentina)

The wish was expressed that the next World Eucalyptus Conference should be held in Australia in 1966 and should be supplemented by a study tour. M. R. Jacobs promised to transmit this wish to his Government.

Three *ad hoc* working parties were set up, consisting of persons chosen in each of the principal eucalyptus-growing regions of the world, namely Latin America, Africa, the Mediterranean basin and Near East, and Asia-Pacific, in order that between now and the next conference the wishes and resolutions communicated by the different technical working parties might be dealt with in a speedier and more co-ordinated fashion. The following members of these working parties have been put forward:

1. *Biological problems*

   M. R. Jacobs (Australia)
   A. de Philippis (Italy)
   R. F. Guimaraes (Brazil)
   H. L. Malherbe (South Africa)

2. *Utilization*

   G. Giordano (Italy)
   C. S. Elliot (Australia)
   J. J. M. Garcia (Argentina)

3. *Plantation economics and utilization of eucalyptus*

   E. Susaeta (Chile)
   K. L. Truettner (Brazil)

The main function of these working parties is to ensure, in liaison with FAO Headquarters in Rome, the implementation of the resolutions and recommendations put forward at the conference by the different technical sections. In the main international organizations or at meetings, their purpose will be to prepare and submit special studies and problems affecting eucalyptus.

In addition the conference asked that FAO should publish a new edition of *Eucalypts for planting*, which had elicited favorable comment in recent years but was now out of print. Certain chapters should be brought up to date and new ones added, a task that will be entrusted to experts working on a voluntary basis and chosen in consultation with the *ad hoc* working parties referred to above.

Lastly, it was requested that further study tours be organized by FAO with a view to the collection of selected seed and on the primary utilizations of eucalyptus timber.

The publication of the proceedings of the conference will be undertaken by the Brazilian Government. These will consist of the reports and resolutions of the conference in the four working languages, together with the technical papers in their original language, either in summary form or *in extenso*, if funds permit.

Hernan Santa Cruz, Assistant Director-General of FAO (Latin-American Affairs, Santiago) chaired the closing session. He sketched a very wide canvas of the problems confronting Latin America and thanked the Brazilian Government for the great success of the Second World Eucalyptus Conference.

FAO Panel on Education in Forestry

Established in 1956, this panel is charged with advising the Director-General on policy and programing of work related to forestry education. The purpose of its third meeting, held in Vienna from 8 to 9 September 1961, under the chairmanship of H. L. Shirley, Dean of the College of Forestry, State University of New York, Syracuse, was to consider the professional manpower supply and requirements in the developing regions, and the extent to which FAO should sponsor the expansion of forestry education facilities during the next few years.

The panel formulated recommendations on a new survey of manpower needs, general principles for the organization of forestry education centers, and the necessary levels of education, and on how to deal with the growing demand for technical experts in developing countries with the resultant need for personnel trained to serve abroad. The panel decided that it should enlarge its membership to ensure wider representation of regions and, more particularly, of the developing countries.

FAO/IUFRO Committee on Bibliography

The twelfth session of the FAO/IUFRO Committee on Bibliography was held from 5 to 7 September 1961 also in Vienna and prior to the thirteenth congress of IUFRO, under the chairmanship of Professor E. Saari of Finland. Developments relating to the use and expansion of the Oxford Decimal Classification System for Forestry, and in the preparation of the FAO multilingual forest terminology were considered.

The Oxford Decimal Classification has now been published in four principal languages (English, French, German and Spanish) and has been widely adopted in countries using these languages as well as in many other countries where national language versions have been prepared.

On the other hand, progress with the preparation of a multilingual forest terminology has been rather slow, although the need is no less urgent. Means of speeding up the work were discussed and will be pursued, especially the securing of adequate financial support. The committee considered that, in the meantime, a temporary multilateral forest glossary should be prepared on the basis of material already available, to answer the increasing demand made by international bodies and conferences and by foreign experts who are working under international technical assistance and other aid programs.

Among other subjects treated was the *World list of periodicals and serials of interest to forestry*, which has been issued by FAO in close collaboration with the Commonwealth Forestry Bureau, Oxford, and with other centers.

FIGURES 1 AND 2.

Study Tours in the U.S.S.R.

Two study tours in forestry were organized during 1961 under the United Nations Expanded Program of Technical Assistance. The first, on logging and floating, was held in June/July in the Leningrad-Moscow area. Foresters from Burma, India, Indonesia and Pakistan participated. Among other features, the research institute on logging mechanization at Chimki and two experimental logging enterprises were visited. One of these enterprises (at Olenino) uses mainly tractors for skidding. The tractor TDT 40 shown in Figure 1 is used for skidding bundles of trees; Figure 2 shows another tractor with attachment which collects trees one by one as they are felled. Lorries are used for transportation to the "lower yard."

The other enterprise (at Krescy) makes use of cableways for skidding and loading (Figures 3 and 4) and narrow-gauge railways for the transport of whole trees with crowns. The delimbing is done by special electrical saws in the lower yard, where the branches are cut off, and the logs bucked, sorted and stored in special boxes for loading into long distance transport. Most logging enterprises in the U.S.S.R. already have or are building some kind of primary conversion plant, mainly for conversion of low quality logs, branches, small-sized timber, and wood waste.

The second tour had participants from Afghanistan, Greece, India, Israel, Pakistan, Sudan, Syria, the United Arab Republic and Yugoslavia, and was concerned in

FIGURES 3 AND 4.

FIGURE 5.

FIGURE 6.

particular with protective afforestation in semiarid and arid zones. Figures 5 and 6, taken of shelterbelt plantings in the Volgagrad area, show two experimental cultivators. The horizontal wheels, with bicycle tires, serve to enable the cultivator to work very close to the plant row without damaging the plants. The cultivator in Figure 6 with the propeller-like blades is being used where the rows are planted on a ridge. It is being dragged along the ridge, the blades letting the plants slip through while moving. Figures 7 and 8 show prefabricated houses at the Volgagrad sawmill. These houses are built in two halves on a steel frame. They are transported in halves and used in places where large work projects are to be carried out.

These study tours are arranged as one means of utilizing the contributions by the U.S.S.R. to the United Nations technical assistance program. Such contributions are for the most part in inconvertible roubles which generally have to be spent within the country itself on the purchase of equipment and machinery or on granting fellowships. The U.S.S.R. authorities are interested in organizing a seminar on aerial forest surveying in 1964.

FIGURE 7.

FIGURE 8.

United Nations Special Fund for Economic Development

Four national projects are now in operation for which FAO, through the Division of Forestry and Forest Products, is acting as executing agency for the Special Fund.

Mexico

This project entails carrying out the initial stages of a national forest inventory, embracing an assessment of the potentially productive but hitherto unexploited forests with a view to establishing forest industries to meet the growing needs of Mexico itself and the export trade. The inventory, which will later be extended by the Mexican Government to cover the whole of the forests of the country, will enable forest management to be undertaken on a sustained-yield basis, and at the same time it will define the limits of the existing forests so that plans can be made for their conservation.

The Special Fund contribution is limited to assisting the Government, which has already established an inventories section at the forest research institute, with the first four years of the national forest inventory. This stage consists principally in carrying out an aerial survey, on which all future work including the ground surveys will be based. The project will include additional equipment for the photogrammetric laboratory already established, aerial photography, inventory equipment and transport. Provision is also made for the services of one expert (F. Hummel, United Kingdom) and fellowships for Mexican staff who will require additional specialized training abroad. A pilot survey of a selected area of tropical forest forms part of the project; the reason for the latter is that techniques for the aerial assessment and ground inventory of tropical forests are far from being standardized, and experimental work will be needed in Mexico to determine the best techniques to suit local conditions.

The project will involve the following phases.

(*a*) Strengthening of the inventories section of the forest research institute to enable it to undertake the survey on a national scale and prepare full working management plans. The forest research institute already has the physical facilities (buildings and land) and essential personnel to start this project. The strengthening will take into account such long-term aspects of forest inventories as changes due to periodicity of growth, extraction, clearance, etc. It is therefore necessary to organize a national system of annual reporting to the Inventories Office of changes in forest conditions.

(*b*) Collection and study of available aerial photographs regardless of whether taken for forestry or other purposes. This stage will be concerned with preliminary map preparation, photo interpretation, photo transfer and the determination of suitable aerial survey techniques. Similar work has already been carried out over selected forest areas in Mexico and this will be evaluated prior to the start of the national forest inventory.

(*c*) The aerial survey remaining to be done will begin in the forest regions of the country that are most accessible and best known as promising for immediate development. These are the states of Michoacan, Durango, Chihuahua, Oaxaca, Guerrero, Jalisco, Veracruz, Coahuila and Sinaloa. The Inventories Office will devise standardized methods of collecting and presenting information, such as definitions of forest types for management purposes. The aerial survey is estimated to cover a total of about 40,000 square kilometers of temperate forests and a pilot zone of tropical forest whose area will be decided by a co-ordinating committee.

(*d*) Ground surveys will follow immediately after the aerial survey of each area. For this purpose the Inventories Office will organize a ground survey section to carry out base mapping where necessary, and ground operations including gathering statistical data. Technical studies to determine the possibility of exploitation will be made during this stage. Operating working plans for each specific area will be worked out over the whole period of the survey, but first attention will be given to areas where immediate industrial development is contemplated.

Chile

This project entails the establishment and initial operation of an institute for the development of forest resources and industries to be created by the Government of Chile.

In co-operation with the Chilean Development Corporation, the Ministry of Agriculture and other interested agencies and institutions, the institute will be concerned with the economic and technical development and the rational exploitation of Chile's forest resources as called for in the national ten-year plan for economic development. It will be charged with the following responsibilities:

(*a*) evaluation of Chile's present and potential forest resources;

(*b*) improvement in management and conservation of these resources;

(*c*) technical assistance for the development of the forest industries by rationalizing the exploitation, processing and marketing of forest products;

(*d*) practical training of both government and industrial personnel at all levels in forestry and the forest products fields;

(*e*) improving the marketing and promoting the demand for forest products;

(*f*) conducting and co-ordinating applied research in forestry and forest products.

The institute will have its headquarters at Santiago, and its work will be initiated with the assistance of a project manager (L. Hartman, Finland) and a team of foreign experts. The duration of the project will be four years, and during this period the project manager will act as adviser to the director of the institute. Field stations will be established at locations to be determined by the project manager in consultation with the Chilean authorities, and use will be made of suitable existing research and training facilities.

The training aspects of the project will receive special attention in the program of work, and the foreign expert staff of the institute will not only be charged with the responsibility for training counterpart personnel at the professional level, but also with developing facilities and programs directed toward training intermediate level personnel for both forest operations and the wood-processing industries. Training courses will be set up to provide practical training for both government and private industry personnel in logging, sawmilling and sawdoctoring, wood seasoning and preservation and other secondary wood-processing operations. Similarly, courses in forest surveys and mapping, mensuration, tree planting and nursery practices, as necessary, may be conducted on the forestry side. The present and augmented facilities at the co-operating universities as well as the equipment from the FAO forest experiment station at Llancacura will be employed as required.

Morocco

A rural economic preinvestment project for the Western Rif entails, during the initial two-year period, a planning study to cover two kinds of activities to be undertaken simultaneously; the framing of a development plan for the entire Western Rif, and the immediate application, within a limited but typical area called the "Taunate spearhead zone" of agricultural, grazing and silvicultural techniques designed to solve the particular economic and social problems of the areas. As soon as sufficient progress has been made in the first phase of the project which has come into being as a result of FAO's program for Mediterranean Development of which Egon Glesinger is the project leader, the project manager will submit proposals for proceeding to the next phase or phases, aimed at placing the economic planning for the entire region on more solid foundations, or to extend it to other similar regions in Morocco.

The Taunate spearhead zone, through which the Unité highway passes, lies in the heart of the Western Rif, and is typical of it as a whole. It occupies about 230,000 hectares and has about 110,000 inhabitants in 13 communes. The demonstration and experimental activities will be centered here. G. W. Chapman, United Kingdom, is the forestry member of the project team.

Turkey

Another project that has grown out of FAO's Mediterranean Development Project is for a preinvestment survey to be undertaken to plan for the balanced economic and social development of the Antalya region. This plan will:

(*a*) constitute the basis for the implementation of the Turkish economic development program in the region;

(*b*) provide a valuable pattern for the formulation and implementation of similar plans for other regions of the country;

(*c*) furnish opportunity for training national staff in the techniques of formulating development plans.

The Antalya region is a natural economic unit situated in the southern Mediterranean part of Turkey, and its present population is about 600,000, of which 90 percent live by farming, forestry and grazing. Four fifths of the land is mountainous and mainly covered with forest or scrub; cultivation extends over 470,000 hectares, 65 percent of the cultivated area being on good plain land, suitable for irrigation. Its development is planned as follows.

(*a*) *Forest program.* This would concentrate on the protection of the existing forest lands, the intensification of forest management and reforestation with quick-growing species. The forest road system would have to be extended and the forest service strengthened. Resettlement of surplus population from forest areas in new employment elsewhere would be an important element. The expert in charge of this sphere is A. Y. Goor, Israel. J. A. von Monroy, who is also working in Turkey on a technical assistance assignment, is helping.

(*b*) *Agricultural program.* Emphasis here would be mainly on the rapid development of irrigation. The present pattern of free range grazing would be gradually changed into a more intensive form of animal husbandry based on the production of fodder crops. Dry farming on the nonirrigated lands would be intensified with the gradual reduction each year of the area under fallow and the introduction of legumes in the rotations. In the irrigated plains, the ultimate aim would be the transition to mixed farming; special attention would be given to increased export, while extensive areas in the lowland scrub would be brought into production.

(*c*) *Industrial program.* The development of hydroelectric energy, the rapid exploitation of such mineral resources as chromite, bauxite and coal, as well as the tapping of sources of natural methane gas would form its chief concern. New industries would be established for processing agricultural, fisheries and forest raw materials. Special emphasis would be paid to the organization of a tourist trade.

FIGURES 1 AND 2.

FIGURE 3.

FIGURE 4.

Institute for the Development of Poplar Culture in Turkey

An institute for the development of poplar culture in Turkey, which is being built at Izmit with the help of E. Vaccarone, an FAO technical assistance officer, is due to be completed shortly (Figure 1). Selection and testing of local and foreign poplar varieties, fertilizer trials, rotation practices with other crops, spacing and cultivation methods and experiments, have been proceeding for some time (Figure 2).

Although poplars are not native to Turkey, they have over the centuries established themselves and are now grown by the million (Figure 3). Turkey is, therefore, a good central country from which to spread poplar cultivation to other countries of the Mediterranean area.

In the Izmit area on the Sea of Marmara the land is swampy and the winds strong. These are ideal conditions for showing the adaptability of poplars to unfavorable conditions and their considerable value in land reclamation and as windbreaks to protect other crops.

There are now about 30 hectares of nurseries and comparative and demonstration plots (Figures 4 and 5). Poplar varieties from Turkey, Italy, Syria, Switzerland, Germany, France, Spain and the United States are being tested. Some 100,000 plants were distributed in 1960 and the production will reach 130,000 this year. By 1962 the Institute will be able to distribute plant material to all the other nurseries in Turkey.

Support is being sought from the United Nations Special Fund for Economic Development to make the Izmit Institute an international poplar center for the region.

FIGURE 5.

FAO Technical Assistance Reports on Forestry and Forest Products

Addenda to the list published in Unasylva, *Volume 15, Number 1, 1961*

Africa

Nigeria

Ref. No		
—	Agricultural Survey of Northern Region of Nigeria Supplementary Memorandum on Forestry (Chapter XVI) - 1961	FAO/ICA team

Tunisia

—	Sur les aménagements forestiers en Tunisie - 1961	P. Cochet

Uganda

1287	Present Wood Consumption and Future Requirements in Uganda - 1961	S. L. Pringle and J.E.M. Arnold

Asia and Pacific

Ceylon

1412	Woodworking - 1961	J. McVeigh

India

1298	Integration of Forests and Forest Industries - 1961	J. A. von Monroy
1349	A Program of Forest Genetics and Forest Tree Breeding Research - 1961	J. D. Matthews

Indonesia

1278	Aspects of Forestry in Relation to the Rayon Plant Project in South Sumatra - 1961	F. Loetsch
1281	Application of Mean Tariffs for the Further Development of Forest Management of the Plantation Forests - 1961	F. Loetsch
1315	Improvement of Fuelwood Cooking Stoves and Economy in Fuelwood Consumption - 1961	H. Singer
1394	Development of Wood Preservation - 1961	W. Liese
1400	Development of the Match, Veneer and Plywood Industry - 1961	K. Fraedrich

Philippines

Ref. No.		
1403	The Philippine Forest Products Research Institute - Its Development and Future - 1961	G. M. Hunt

Thailand

1375	Development of the Thai Plywood Factory - 1961	K. Fraedrich

Europe

Turkey

1360	Silviculture - 1961	F. Zednik
1362	Soil Conservation and Range Improvement in Problem Watersheds in the Forest Zones of Turkey - 1961	G. W. Chapman
1421	L'industrie, le commerce et l'exploitation des bois feuillus - 1961	M. Hans

Near East

Sudan

1372	Development of the Forest Industries - 1961	M. N. Gallant

Syria

1314	National Forest Policy for Syria - 1961	M. D. Chaturvedi

Latin America

Argentina

1325	Actividades Forestales en las Zonas Aridas y Semiaridas - 1961	A. Y. Goor

Brazil

1337	Application of Silvicultural Methods to Some of the Forests of the Amazon - 1961	J. Pitt

Colombia

1219	La Industria Colombiana del Papel y la Celulosa: Situación Actual y Tendencias Futuras - 1960	Grupo Asesor en Papel y Celulosa para América Latina

Peru

1348	La Industria Peruana de Aserrar Madera - 1961	M.A.F. Dijkmans

News of the World

Australia

• As a result of the recommendation of an Australian who spent six months in Malaya as a Colombo Plan expert to advise on Malayan industry, a delegation of 30 Malayan forestry and sawmilling representatives made a two-week inspection tour of timber areas of New South Wales during July 1961.

During eight days on the north coast of New South Wales, the delegation visited a hardboard factory, eight hardwood sawmills, one plywood factory, a pole preservation plant, and two sawmill machinery manufacturers' plants. One whole day was spent in a densely stocked forest management area to see Australian methods of tree felling, tractor skidding and hauling of hardwoods and scrubwood. Road making in this area, which is carried out by the Forestry Commission, was also inspected.

On returning to Sydney, visits were made to three of the largest timber yards which also carry out resawing as well as having joinery shops, drying kilns and impregnation plants. A two-day inspection was also made of an area 150 miles west of Sydney, where the Forestry Commission is conducting large-scale planting of exotic conifers, principally *Pinus radiata*. In this area two softwood sawmills and one chipboard plant were visited.

France

• Agricultural extension activities were for a long time the responsibility of the public authorities, but a decree issued in 1959 formally transferred this responsibility to independent farming associations, reserving to the State only over-all direction and promotion. Extension programs in regard to forestry fit well into the new system, having for objective the creation of viable management units and encouragement of the investment needed for intensive afforestation.

The forest administration authority has especially encouraged the forming of a national professional association to foster the spread of sound forest management techniques among owners, and has organized technical training for extension workers to be recruited by the various private associations. According to a report to the European Forestry Commission of FAO, these are largely drawn from among former students of the Ecole technique professionnelle agricole et forestière du Massif central at Meymac, Corrèze, and from holders of agriculture diplomas having studied forestry as an optional subject.

Germany, Western

• *Die Waldwirtschaft und Holzindustrie der Sowjetunion* (Erwin Buchholz, BLV Verlagsgesellschaft, München-Bonn-Wien, 1961, p. x + 223, 66 illust. DM 28) deals with the efforts being made to develop further one third of the forest area of the world, located in the U.S.S.R., and to establish proper techniques for the management of forest production and protection, and a modern and integrated forest industry. It is the second publication of a new series entitled World Forestry and edited by J. Weck of Hamburg/Reinbek. (The first volume of the series dealt with world forestry and Germany's forestry and forest products economy.)

During the last 30 years, E. Buchholz has become one of the few experts on forestry development of the U.S.S.R. outside that country. He has had published several papers and books, but this last one gives the most comprehensive picture of all, starting with the historical background; leading to the ecological conditions (with forest formations and main species); the protective functions of the tree cover; statistics of forest areas and growing stock; the organization, administration and management of forestry and forest industry; and the production, transport, trade and consumption of forest products.

Guiding lines of Soviet forest policy are based on large-scale afforestation in the south and the utilization of untapped forests in the north and east. The special task is to make accessible and to utilize the vast coniferous resources of the taiga, where — in the framework of the present seven-year plan and with large financial investment — big wood-industry combines with mechanical and chemical processing units, including pulp and paper industries, are being established.

Italy

• The major area for poplar growing is still the Po valley where the climate and soils are suitable and where economic and rural conditions are also favorable. But, since the demand for raw materials by the paper industry is on the increase and the prices offered are good, the growing of poplars is spreading especially on marginal land where farming cannot yet, or is no longer able to, produce adequate returns. This is observed in central and south Italy and in the islands, where the use of special techniques in the planting of highly vigorous clones having a long growth period makes up for the less favorable conditions compared with the Po valley.

Eucalypts also are spreading as a specialized crop especially where poplar does not thrive and where resistance to drought is required. The experimental centers set up by the *Ente Nazionale per la Cellulosa e per la Carta* near Rome is particularly interested in this development in Sicily, Sardinia, Maremma (Tuscany), Latium and the Pontine marshes.

Kenya

• *Kenya trees and shrubs* (Buchanan's Kenya Estates Ltd., P.O. Box 3963, Nairobi, Kenya, in association with Hatchards, 187 Piccadilly, London, £4.4.0.), which is published by authority of the Government of Kenya, is particularly valuable for foresters, botanists, all field workers and nature lovers as well as for sawmillers, timber users and architects. It is a comprehensive record of indigenous trees and shrubs of 6 feet and more, which will enable not only the professional forester but also the layman to identify the woody flora of Kenya. While giving accurate botanical descriptions sufficient for identification and timber utilization, together with keys to the families, genera and species, a glossary, vernacular names and other matters of general interest, it is written and produced in a manner that makes it both attractive and invaluable.

Of the joint authors, I.R. Dale has

had a lifetime of service in the Forest Departments of Kenya and Uganda. P.J. Greenway retired from his post as botanist-in-charge of the East African Herbarium in 1958 after nearly 30 years of botanical work in East Africa.

European and American orders should be sent to Hatchards, London, and African orders to Buchanan's Kenya Estates, Nairobi.

Outer Mongolia

• Forests are said to cover only about 8 percent of the country's total area but still amount to around 12 million hectares, despite the average altitude of some 1,500 meters above sea level, the low relative humidity, precipitation of about 350 millimeters per annum in the north and only 150 millimeters in the south, and considerable extremes in temperatures daily and over the year.

Most of the forests are composed of conifers and situated in the montane taiga belt in the north of the country. Siberian larch is the principal species, followed by Siberian pine, Scots pine, birch and aspen. Some poplars, elms, and saxaul thickets are found in the Gobi desert areas, in the southeast of Mongolia. Timber demand is growing, and it is reported that improved management, conservation, protection and afforestation measures are being instituted as a result of technical aid on a considerable scale from the U.S.S.R. and China. A regular annual cut of some 2-2.5 million cubic meters may become quite feasible in the accessible forest region. The railway system is being connected to the railways of both China and the Soviet Union.

South Africa

• Thirteen percent of the area afforested with exotic species, or 67 percent of the area planted with Eucalyptus species, is occupied by *E. saligna*, which covers 241,500 acres (98,000 hectares) (the name *E. saligna* is in South Africa applied to *E. grandis* (Hill) Maiden and *E. saligna* Smith, as well as transitional forms between them; there is comparatively little true *E. saligna*). A publication by A. van Laar: Eucalyptus saligna *in South Africa: An investigation into the silviculture and economics* has appeared in the series, Annals of the University of Stellenbosch (Vol. 36, Ser. A, No. 1, 1961). It gives a detailed review of the position of the species in regard to ecology, silviculture, growth factors, yield, logging, and economics of plantations.

Nine tenths of these plantations are privately-owned. Rotation (mostly between 6 and 20 years), tending and regeneration methods vary according to production aims. Seven site indexes were established, top height at the age of 25 years being 200 feet (60 meters) for Class I and 80 feet (25 meters) for Class VII. The volume production, to 3 inches (7.6 centimeters), is about 5,000 cubic feet per acre (350 cubic meters per hectare) at the age of 12 years, for Class IV in unthinned stands. For the same site class, maximum land expectation values are obtained at a rotation of 10 years, and in Transvaal and Zululand respectively are 171 and 107 rands per acre ($590 and $370 per hectare) and in Zululand, respectively. The cost price is 5.9 South African cents per cubic foot ($2.91 per cubic meter) for a rotation of 13 years and 7.5 South African cents per cubic foot ($3.70 per cubic meter) for a rotation of 18 years, in saw timber plantations. The entrepreneur's annual gain in unthinned mining timber and pulpwood stands, still for Class IV, is 4 to 7 rands per acre ($14-25 per hectare) at 8 years rotation, and in heavily thinned stands producing saw timber in a normal forest it is between 12 and 13 rands per acre ($41-46 per hectare) on a 13-year rotation.

The age-class distribution of *saligna* is approximately normal, and the annual production may be estimated at 68 million cubic feet (1,93 million cubic meters), or 42 percent of the total production in South Africa (1958). This percentage will decrease when the age-class distribution of other plantations, especially pine, becomes more normal. A forecast for the year 2000 estimates that South Africa, while exporting considerable quantities of pulp and board products, will still have to import large quantities of building and structural timber.

Tibet

• It is reported that Chinese assistance is concentrated on the conservation of existing forests and large-scale afforestation with quick-growing species. The forest area of Tibet is not known with any certitude but is estimated at over one million hectares, located mainly in two areas: the Gartok area of western Tibet and in the southeastern corner of the country. The main commercial species are juniper, pine and spruce, with poplar, bamboo, and fir in the more temperate areas. All the forests are now state-owned.

United States of America

• The Department of Agriculture has been making a number of substantial grants for research to be carried out abroad. These include grants to the Peru Forest Service, for taxonomic studies on forest trees; to research institutes in Spain for research on pests of poplar, forest fire behavior, and trace elements required for the growth of *Pinus radiata*; and to the University of Chile to investigate the use of artificial light in stimulating growth in pine cutting.

Viet-Nam, North

• According to a press report, both the U.S.S.R. and China are helping North Viet-Nam to develop its forestry. Capital and forestry experts have been made available, while students are being trained at Moscow, Leningrad and Peking. Tractors are beginning to replace the traditional buffalo and elephant in timber extraction, and heavy roadmaking equipment is being used to open up the rich tropical rain forests to the powersaw. As a result, exports of hardwoods are now in the region of 50,000 cubic meters per annum, and some of this timber is sent to Eastern Germany and Czechoslovakia. It is said that afforestation is being carried out on the sandy coastal areas using pines, *Cunninghamia* and eucalypts; and the "rai" system of burning forests for shifting cultivation is being stopped.

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Timber Trends and Prospects in the Asia-Pacific Region A study prepared jointly by the secretariats of the Food and Agriculture Organization of the United Nations and the United Nations Economic Commission for Asia and the Far East. English. French in preparation.	2.00	10s.
Yearbook of Forest Products Statistics, 1961 Fifteenth in the series of yearbooks containing statistical data obtained from more than 100 countries during the two years preceding publication. Tables deal with production, trade and consumption of roundwood, sawnwood, sleepers, plywood, woodpulp, varied types of paper, paperboard and fibreboard. Salient features of the current world forest products situation are included. Trilingual.	2.50	12s. 6d.
The State of Food and Agriculture 1961 The authoritative annual review of developments in the world food and agricultural situation, with a year-by-year report on the outlook for the future. Detailed studies on special subjects are also a feature. One of the most important of FAO's publications. In English, French and Spanish.	2.00	10s.
Rural Problems in the Alpine Region An international study on the economic and social problems of Alpine populations, dealing with land use and tenure, soil conservation, occupations and production, institutions and social conditions and the demographic trends and population structure. One major conclusion of the study is that development programs should be framed on an appropriate regional basis. The methods adopted in carrying out this project will be of interest for mountain areas where economic and social conditions give cause for concern. In English and French.	1.50	7s. 6d.
Rural Tanning Techniques (*Agricultural Development Paper No. 68*) Selected methods and processes of techniques in tanning, including descriptions of tools and equipment required by rural tanneries, with full explanation of how improvements can be introduced. A publication designed especially for training purposes. In preparation.		
Soil Erosion by Wind and Measures for its Control on Agricultural Lands (*Agricultural Development Paper No. 71*) The process of soil erosion, its effect and the conditions relating to soil erodibility. Methods of control successfully used in North America, Australia and elsewhere are described. Recommendations are made for control measures which might be applied in lesser developed countries. In English, French and Spanish.	1.00	5s.
Man and Hunger In connection with the Freedom from Hunger Campaign launched by FAO in July 1960, a revised version has been issued of this booklet, which was prepared jointly by FAO and UNESCO and first published in 1957. The booklet outlines the problems of making better use of present agricultural land and cultivating hitherto unused land, and disputes the view held by many experts that land resources are approaching exhaustion. The limits of potential food production may never be reached, "for as we travel toward them they recede with the steady advance of knowledge." The booklet reviews the various methods by which the underfed parts of the world can be helped. FAO has projects for research on plant and cattle pests and diseases, on the possibilities of fish-farming, and in nutrition on the problem of raising the protein content of diets. The Freedom from Hunger Campaign aims to arouse public opinion in the better-fed parts of the world and to ask for practical help in improving the lot of the other 1,500 million people who are underfed. In English, French and Spanish. (Special prices for bulk orders)	0.25	1s. 3s.

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